NATIONAL PETROLEUM NEWS

TECHNOLOGY DEPT.

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DETROIT

Palm Trees Frame Diesel Fueling Rack on Guam

YES, these really are palm trees! The place: Diesel tank farm, Island of Guam. Depicted are four officers—three of them from the oil industry—of the Fuel Section, Naval Supply Depot, Guam. (See NPN May 23, p. 4). They are standing before one of two Diesel fueling racks, which dispense about 100,000 gal. per day into tank trucks for distribution to the many military activities based on this island.

Shown, left to right, are: Lieut. J. Dimeling, Jr., assistant fuel officer in charge of harbor fueling; Lieut. Comm. Sid Goldin, chief fuel officer and formerly an assistant marketing division manager for Shell in New York; Lieut. Comm. W. W. Craig, recently with Gulf in Philadelphia and now will head the new testing laboratory to be erected on Guam; and Lieut. L. Lowery, assistant fuel officer in charge of logistics and safety and before his entrance into the Navy a petroleum inspector for E. W. Saybolt & Co. at Corpus Christi, Tex.

Inset shows Lieut. W. J. Grumm, former construction engineer for California Standard, and now the Seabee officer in charge of all petroleum installations on this island.

Three of Grumm's eight years with Standard were spent in Arabia, and he has been on Guam since just after it was retaken from the Japs.

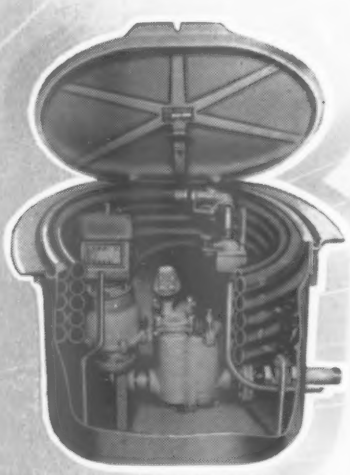
HIGHLIGHTS IN THIS WEEK'S NPN—

Veteran Division Manager Discusses Lessee Rentals: Instead of raiding your competitors for likely prospects for station managers why not try recruiting new blood from successful business men in other lines? This is among helpful suggestions offered by a marketing executive out of his 40 years experience in the oil business. Details are in the third report on NPN's coast-to-coast survey, "What's Ahead on Lessee Rentals?" **Turn to p. 16**

The Postwar Oil Market in Europe: Splitting up European markets into import and distributor quotas may lead to legalized international cartels, is the warning sounded by Charles J. M. van Bergen, New York, prominent exporter. **See p. 38**

Another Chapter of Fighting Oil on the Fighting Fronts: Herbert A. Yocom in another of his dispatches written during his tour of the Pacific theater tells of the experiences of Lieut. D. A. Singleton during the Jap attack at Pearl Harbor. Lieut. Singleton was the first industry man to serve in the Pacific area. Editor Platt continues his reports on POL men in the Mediterranean area. **Mr. Yocom's report starts on p. 6, Mr. Platt's on p. 8**

ERIE SR. PIT made in 2 capacities Fig. 2150-50 G. P. M. with 1½" hose, nozzle and equipment; Fig. 2100-100 G. P. M. with 2" hose, nozzle & equipment. These sturdy steel cabinet units measure 44½" wide - 59½" long by 38⅝" deep. They include hose reel, meter, register, air release, strainer, control valve, control switch, completely assembled ready for installation. Write for booklet SR.



ERIE JR. PIT made in 2 capacities Fig. 2125—20 to 25 G. P. M. with 35 ft. of 1" hose and nozzle; Fig. 2140—30 to 40 G. P. M. with 35 ft. of 1¼" hose and nozzle. This sturdy self contained steel cased pit measures 24" high, 29" wide and 39" long. Write for booklet JR.

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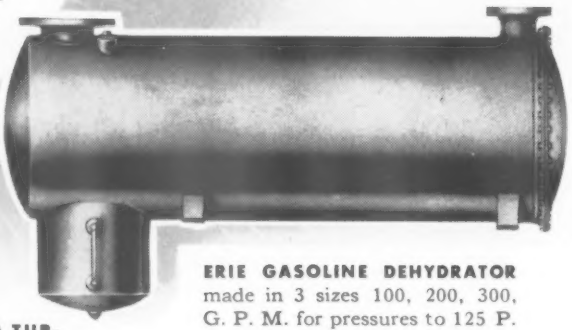

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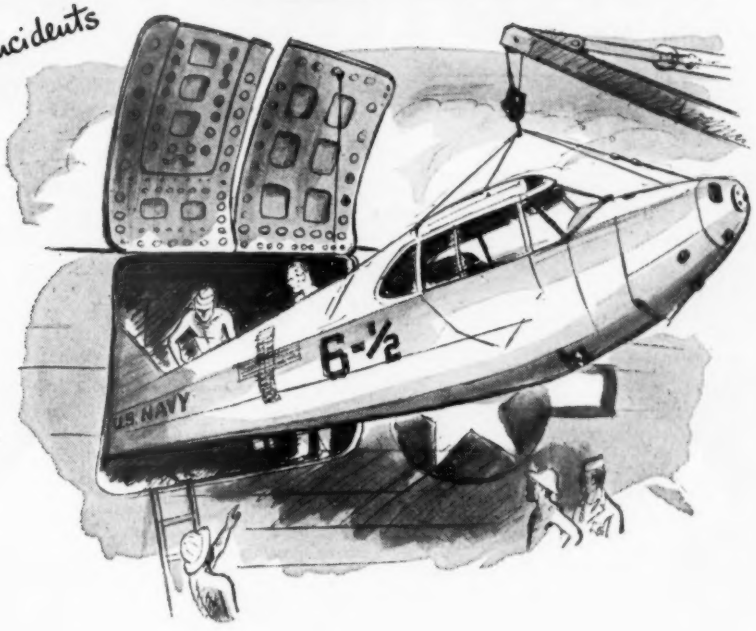
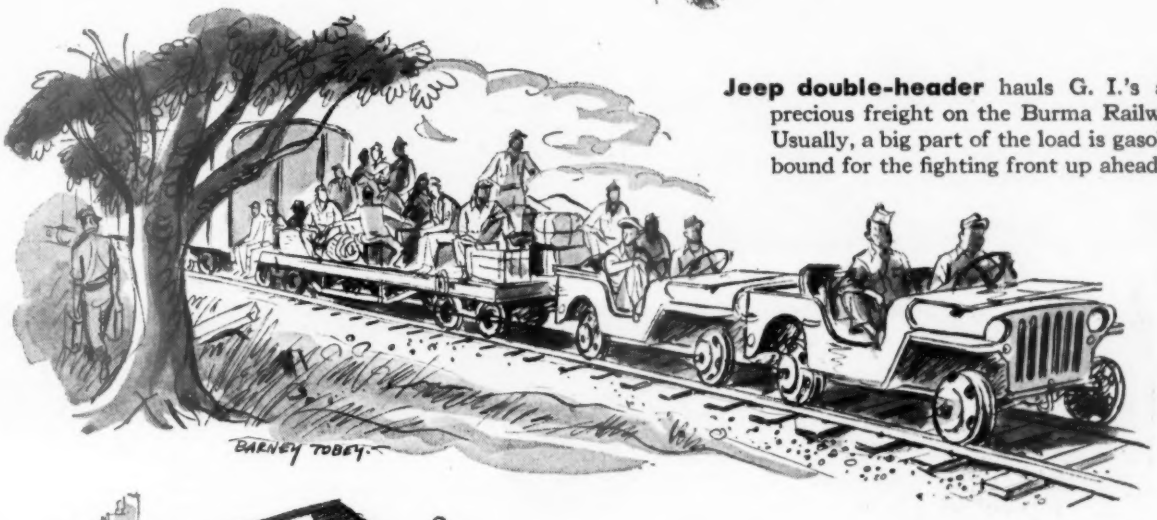
Rough impressions of gasoline's role on the battle-fronts – based on actual incidents and official photos.



A Curtiss Commando carries Cub hospital planes two at a time, kangaroo-style. To fly this load, plus a ton of priority equipment, high octane gasoline is essential.



Jeep double-header hauls G. I.'s and precious freight on the Burma Railway. Usually, a big part of the load is gasoline bound for the fighting front up ahead.

Navy boats don't always ride the waves. This one, for example, goes overland on the sturdy back of an Army truck. Ashore or afloat, mechanized equipment in this war needs gasoline of the finest quality and plenty of it.

KNOCKING OUT a tough enemy is a job that takes men, machines and supplies — including huge quantities of the best gasoline that American refiners can produce—gasoline improved with Ethyl fluid.

So long as the best gasoline "is still fighting," gasoline allotted for civilian use must be restricted as to quality as well as quantity. Lessened military needs may ease the situation a bit, but the lifting of all restrictions cannot be expected until complete, final Victory.

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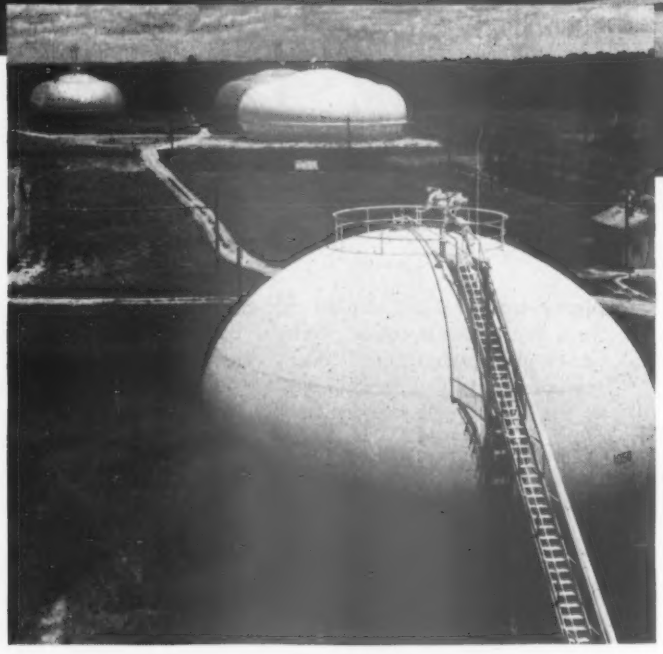

Marketing Terminals . . .

■ *Above: The Hortonspheroids shown above are located at a marketing terminal. The two large ones have a capacity of 50,000 bbls. each and the small one holds 6,000 bbls. All three are designed to operate at 2½ lbs. per sq. in. pressure.*

Left: The Hortonspheroid in the lower right has a capacity of 10,000 bbls., the two in the upper right hand corner hold 80,000 bbls. each and the one in the upper left hand corner has a capacity of 40,000 bbls.

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MINIMIZE EVAPORATION LOSSES DURING THE STORING OF MOTOR FUEL

■ The product-loss, through evaporation, that takes place during the storing of motor fuel at marketing terminals is determined largely by the type of storage tanks used. Pressure storage, as provided by Hortonspheroids, is the logical type of tank for motor fuel in capacities 2500-bbls. or larger. The effectiveness of these tanks in stopping evaporation is indicated by the chart shown below. The top curve in the chart shows a continuous record of the actual pressures in a Hortonspheroid storing motor gasoline for a period of seven weeks during July and August. The lower curve shows atmospheric temperatures recorded at a nearby weather station.

During the first three weeks of the period, the average daily temperature was fairly uniform and the pressure in the Hortonspheroid did not approach the setting of the relief valves. The valves did not open and no evaporation loss took place.

Fourteen times in the following four weeks, the pressure exceeded the setting of the relief valves momentarily and vapor was vented for short periods. Once venting was caused by filling.

In spite of the fact that this Hortonspheroid vented 14 times, there was little evaporation loss as the period of venting each time, except the one caused by filling, was short and the cubic footage of vapor lost was very small. All venting could have been stopped by using a Hortonspheroid operating at a higher pressure. Most installations however, are designed to prevent losses from normal temperature variations. The extra cost of a tank designed to operate at a high enough pressure to prevent all loss during excessive temperature variations is seldom warranted.

Write our nearest office for quotations on Hortonspheroids as well as other types of storage tanks for storing petroleum products.

REDUCE EVAPORATION LOSSES WITH THESE PRESSURE STORAGE TANKS

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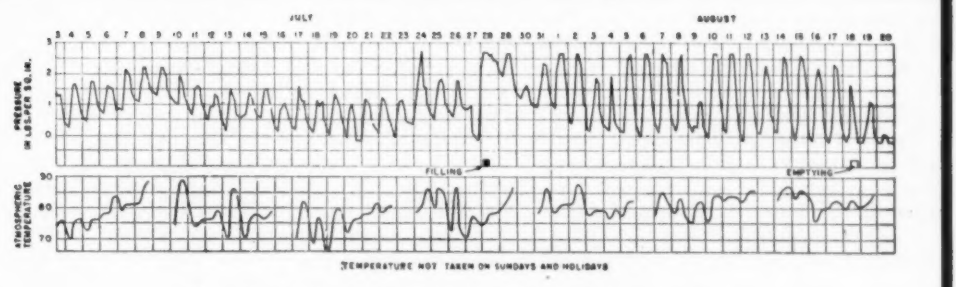

The chart above shows the atmospheric temperature and pressure inside of an actual Hortonspheroid in service.

& IRON COMPANY

Chicago 4.....2125 McCormick Building
San Francisco 11.....1260-22 Battery St. Building
Philadelphia 3.....1614-1700 Walnut St. Building
Los Angeles 14.....1422 Wm. Fox Building
Washington 4.....703 Atlantic Building

and GREENVILLE, PENNSYLVANIA

Maj. Lawrence A. Braden . . .

Wounded Paratrooper Cited for Bravery

MAJ. LAWRENCE A. BRADEN, a soft-spoken, hard-hitting California oil man who was in some of the most spectacular engagements of the European war, has returned to his desk at the Tide Water Associated Oil Co. after approximately three years of service in the Army.

He served with distinction in the invasion of France on D-Day, was decorated with the Bronze Star for meritorious service in action in Normandy, and received letters from the commanding general of the Eighth Air Force, "Jimmy" Doolittle, and from Maj. Gen. Curtis E. LeMay, commending him for special service.

Maj. Braden had been assistant petroleum engineer with Tide Water when he entered the armed forces shortly after the Japs' sneak attack on Pearl Harbor. He went in as a lieutenant and came out a major with the rating of a "superior."

The wiry major was an officer of the famous 101st Airborne Division which received so much recognition in the holding of Bastogne during the Nazi breakthrough. This was the action during which Gen. McAuliffe hurled his classic retort of "nuts" to a German ultimatum to surrender. He invaded France on D-Day with the 501st Paratroop Infantry with 550 men under his command.

Maj. Braden was injured when he landed by parachute on the roof of a two-story house in the village of Ste. Marie-du-Mont, France. Despite this injury and the fact that the village was strongly held by enemy forces, he fought his way out of the flaming shambles that had once been a peaceful community. When he broke through he headed for his battalion assembly area. En route, he assembled several other paratroopers and joined elements of his battalion and division headquarters moving on the town of Pouppeville. Maj. Braden and his group were given the mission of protecting the flanks and rear of the main body during the advance.

Several small attacks were made by the enemy, one of which Maj. Braden personally repulsed although armed only with a pistol. In the citation for this meritorious service it is stated that "his actions were in accordance with the highest standards of the military service".

Despite the injury he suffered in his parachute landing on D-Day, Maj. Braden served continuously until he was discharged last February.

He started his career in the oil business with Tide Water in 1936, as a clerk in the oil fields. A year later he was advanced to assistant petroleum engineer. Upon returning to civilian life, Maj. Braden has taken up his duties as Petroleum Engineer for Tide Water at the Ventura Avenue Field, Calif.

Maj. Braden is 35, married, and has one son, Lawrence A. Braden Jr. He is a member of the American Institute of Mining and Metallurgical Engineers.

INDEX

Coming Meetings	46
Eastern Rail Hauls	30
Markets	49
Oil Prices	51
Oil Transportation	26
Personals	56
Pipelines	10
Production News	36
Refining News	32
Statistics	50
U.S. and British Confer on Jet Engines	26
War Oil Orders	40
Washington News	12

BULLETINS

GILLETTE QUITTING SPB

WASHINGTON — The Surplus Property Board's policy regarding disposal of the war-born pipelines, including the Big and Little Inch, and other petroleum facilities owned by the government for making aviation gasoline and other war products will not be completed "for several months," SPB Chairman Gillette said as he prepared to leave that post.

Gillette's resignation from the board within the next few weeks was announced by the former Iowa senator as he left the White House after conferring with President Truman.

° ° °

DEMURRAGE ORDER REMAINS

WASHINGTON — ODT Director Johnson this week refused to recommend easing of ICC's demurrage order for tank cars, because there is still a shortage of "several thousand tank cars to handle material certified by SPB and the PAW as essential to the war effort. This includes many requests for tank cars to transport asphalt in connection with which we make a special effort to furnish suitable equipment".

° ° °

REFINERS DIRECTIVE RENEWED

CHICAGO — PAW 2 Dist 2. Director E. J. Bullock has issued a wire directive to 46 Midwestern refiners renewing, effective June 1 and for an indefinite period, the May order for approximately 50,000 b/d of 702 Navy Diesel fuel and Pool 21 gas oil.

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Replacement Cost in Crude Is Main Issue With Judd Called for Hearing Next Week

Patman Reveals Five-Letter Exchange With OPA Oil Pricer; Asks if Small Business Committee Principle Is Followed

NPN News Bureau

WASHINGTON—Public hearings on crude prices will be held June 12 and 13 before the House Small Business Committee to determine if OPA has followed the committee's specific recommendation of last December that amortization of exploration costs be taken into account by the agency in setting crude price ceilings, Chairman Patman (D. Tex.) announced this week.

At the same time, Mr. Patman released five letters exchanged between himself and Orville Judd, associate director of OPA's Fuel Price Division, dealing primarily with OPA's stand on the relationship between replacement costs of finding and developing crude and the need for possible price increases.

Mr. Patman said that the crude costs survey, recommended about six months ago is under way, but is "nowhere near completion."

"We shall ascertain in the coming hearings," he said, "why there has been the delay. Also whether the study is being made on the basis recommended by the Small Business Committee."

Witnesses will include Mr. Judd; J. K. Wadley, Texarkana, Tex.; Wallace B. Jayred, vice-president, Superior Oil Co., Houston, Tex.; James V. Brown, secretary of OPA's National Crude Oil Industry Advisory Committee, and possibly other officers of that group. The Independent Petroleum Assn. of America will be represented by several witnesses, including Russell B. Brown, General Counsel; Merle Becker, vice-president of W. C. McBride, Inc., St. Louis, and H. B. Fell, Ardmore, Okla., executive vice-president of the association and president of Simpson-Fell Oil Co.

Judd Reports Complications

The first letter from Mr. Patman to Mr. Judd was dated March 12. In it the congressman asked the OPA official to answer two questions: Why OPA did not consider replacement costs when examining need for possible crude price increases, and whether OPA would permit a member of the advisory committee to have access to the detailed information collected in the survey and be allowed to work with OPA on the examination, analysis and interpretation of the cost figures to be reported by the producers.

In his reply, dated March 24, Mr. Judd said that the survey of both crude production and refining had "become quite involved, due to the desires of industry, on the one hand, to provide information which would indicate the need for price relief and the necessity on our part to see that such information and the findings therefrom conform to the standards of the OPA."

He said that OPA gave "full consideration" to finding and developing costs "but we did not give such consideration on the basis of estimated reserves found." He explained further:

"In other words, we have advised the industry that all costs should be set forth on the proposed questionnaire but that in our determinations we will not use an estimate reserve figure but will use the actual dollars received by the industry for production sold during the same period.

"As you undoubtedly know, reserve figures are at the best mere estimates. If you will refer to the reserves as set forth by the American Petroleum Institute and the Petroleum Administration for War each year, you will find that

(*Continued on p. 46*)

War Department Gives Data On Four Fire Bomb Types

NPN News Bureau

WASHINGTON—Four types of thickened gasoline "fire bombs," ranging in size from six to 500 pounds, were named by the War Department this week as the weapons which will "systematically and effectively" burn out Japanese war industries as air warfare accelerates in the Pacific.

In addition, there is the 1100-pound jettisonable fuel tank, which the Army says can spread its 165 gallons of gasoline gel the length and breadth of a football field when the tank is released as a unit from the plane.

Smallest of the Chemical Warfare incendiaries is a six-pound bomb, the M69, which is filled with jellied gasoline and dropped in clusters. The cluster is opened in midair by means of a time fuse, releasing a shower of firesticks on the target.

The 10-pound M74, described as a tube with piston-like operation that spreads burning synthetic lava a distance of 25 yards, contains jellied gasoline, magnesium powder, white phosphorus and other ingredients.

Heavier bombs also containing jellied gasoline are the thin-walled, 100-pound M47, with a 40-yard fire-power radius, and the 500-pound M76, or "goop bomb." This quarter-ton blockburner contains powdered magnesium, liquid asphalt and other ingredients, in addition to gasoline.

With these bombs already in use, Chemical Service technicians are continuing the search for even deadlier "calling cards" to drop on the Japanese homeland, the War Department said.

NATIONAL PETROLEUM NEWS
NPN
NEWSMAGAZINE FOR OIL MANAGEMENT MEN

I.P.A.A. Council Head Eyes OPA Windup

Special to NPN

INDIANAPOLIS — Independent marketers are deeply concerned with the fact that from all appearances OPA is seeking to perpetuate its life after the need for the agency has passed, Phil T. Williams, president of Indiana Independent Petroleum Assn., said in a letter on June 1, sent to all senators and representatives from this state. He urged that the extension of OPA be for no more than six months, as it is the general consensus, he said, that business would be in a better position to get rid of various regulations as they become unnecessary if renewal of OPA authority comes before Congress oftener than once a year.

OPA's present price authority expires on June 30, and Sen. Taft (R.O.) recently proposed a three-month extension. Extension for a six-month period would correspond to the present expiration date of the OPA ration control law.

Mr. Williams also wrote members of the National Council of Independent Petroleum Assns., of which he is chairman, suggesting that they follow up by writing their Senators and Congressmen, if they agreed that a short renewal term for OPA is desirable.

In another letter addressed to President Truman, Mr. Williams told the President that he had been charged by N.C.I.P.A. "with the pleasant duty of commending you for the splendid way in which you have been carrying on the functions of the office of the President."

"We are especially pleased to note that you immediately started to cut appropriations," he continued.

He agreed with the President that there can be no tax reduction until end of the war.

(*For report from Washington on OPA extension bill see page* 44).

500,000 Tires Are Released For Civilians During June

WASHINGTON — A total of 10,000,000 new synthetic rubber passenger car tires were made available for replacement use the first half of this year, OPA announced. The total includes 500,000 released this week for June distribution.

Specific tire sizes are to be indicated on certificates for large truck tires issued after June 5 and for small truck tires after June 11, OPA said, as a supply and production control measure.

With Herbert A. Yocom in the Pacific—

Tanker's Deck in Middle of Battleship Row Was Vantage Point When Oil Supply Officer Watched Japs Attack Pearl Harbor

Lieut. Singleton, First From Industry in Pacific War, Saved Ship, but Wonders How; Other Veterans in Key Jobs at Base

By Herbert A. Yocom
Chief, NPN Washington Bureau

PEARL HARBOR, Hawaii — Navy Lieutenant D. A. Singleton had just completed supervising the discharge of 800,000 gals. of avgas from a tanker when the Japs struck at Pearl Harbor on Dec. 7, 1941.

Mr. Yocom

From the tanker's position in the middle of "Battleship Row" he heard and saw the enemy planes as they came in over the mountain range that backs up the harbor. He recalls now remarking to an assistant that they made a pretty sight and then going on about his work, thinking that they were American planes out for morning practice.

Well, the planes weren't American and Lieut. Singleton has been knee-deep and over in history's biggest war ever since.

The Japs didn't get the tanker that day —although they have since—but this first U. S. oil man to participate directly in the Pacific operation is still scratching his head and wondering why. And he shudders to think of what would have happened had the little yellow men managed to put a torpedo into the tanker, for she still held 100,000 bbls. of black oil. As it was, torpedoes went by on both sides and she was strafed from the sky, but somehow Lieut. Singleton and the ship's crew managed to get her out into the stream and away safely.

Lieut. Singleton is the son of the late Milton R. Singleton, vice-president and general manager of Valvoline, and the war job he now holds is that of deputy to Rear Admiral J. J. Gaffney, supply officer and petroleum co-ordinator for the Fourteenth Naval District, which includes the Hawaiian Islands.

Left Valvoline for Navy

The lieutenant is one of many former oil men who are active in the 14th District organization, as he had some five years' experience in the industry before coming out in July, 1941, as fuel officer at the Naval Air Station. His first work was in Eastern States Petroleum's laboratory at Houston, Tex., in October, 1935, after which he was employed on the cracking still operation until December, 1937, when he went with Valvoline. When he entered the Navy he was assistant to the manager of that company's Eastern Division, handling mostly light products.

(This article was prepared while Mr. Yocom was still in the Pacific war area.)

Two other industry men occupying key spots in the local setup are long-time veterans of Shell and The Texas Co.—Lieut. Commander J. W. Malseed, who managed Shell's Marine Department at Wilmington, Calif., and Lieut. J. P. Golden, who left his job as a Texaco sales representative in New York to get into "this affair" and has been out here now for more than 15 months. Mr. Malseed arrived at Pearl only last January, but behind him were many months of duty as executive officer of the petroleum pool at San Francisco, which he had helped organize under Rear Admiral J. F. Hatch.

Both men hold the same title—that of assistant to the officer in charge of

Lieut. D. A. Singleton . . . he's still wondering

Left to right, Lieut. J. P. Golden and Lieut. Comm. J. W. Malseed are key officers in the setup at the Naval Fuel Annex, Pearl Harbor

Lieut. (jg) Hollis E. Jones, USNR, tanker operations officer, area petroleum office, on the staff commander service force, Pacific fleet. (See NPN, May 30, p. 5)

Lieut. A. J. Young Bosses Gigantic Oil Drum Farm on Oahu

PEARL HARBOR, Hawaii—Silent attack dogs patrol the grounds around the "home" of a former Buffalo oil man, A. J. Young, here on the island of Oahu.

There's real reason, too, for Lieut. Young lives and also makes his headquarters right smack dab in the middle of about the biggest filled-drum storage farm to be found in all the Pacific—a farm from which has flowed much of the initial supply of packaged oil products for the attack on Japan.

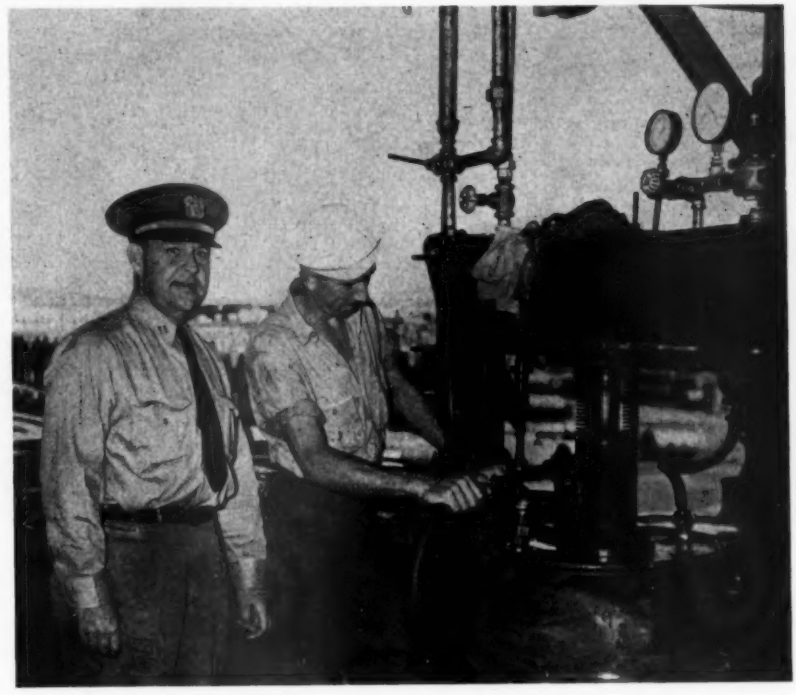
The dogs, incidentally, don't even know the lieutenant "from sour grapes" and would just as soon chew off his leg as that of any would-be saboteur.

Before entering the Navy a little over two years ago, Lieut. Young was terminal superintendent at Buffalo for Frontier Fuel Oil Corp. The Navy didn't wait long to send him to the Pacific, and he has been having a big hand in the oil show in the 14th Naval District for the last 20 months.

Lieut. Young not only has charge of the drum farm but also bosses the operation of what now is the westernmost drum reconditioning plant in the world.

The drum farm covers something like 250 acres, having grown from an original storage area of only 84 acres. At one time, somewhere between 500,000 and 600,000 filled drums were stored there, but recent installation of new filling facilities, operating off a pipeline, has made it possible to reduce the inventory somewhat since Lieut. Young can now "drum up" on motor fuel whenever called upon. Only mogas is filled off the line, incidentally, other products, including avgas, fog oil, Diesel fuel, kerosine, white gas, being drummed either in the states or elsewhere on Oahu and then brought here for storage.

Since March 1, the drum reconditioning plant has been operating on a 24-hour basis and there are now close to 200,000 empties, brought in from all over the Pacific where American forces have been fighting, waiting to go through the plant, which has a capacity of over 1,000 daily.



Lieut. A. J. Young stands by as an enlisted man hooks up the "straightener" at the Navy's drum reconditioning plant on Oahu

The reconditioning process is a speedy one and goes something like this: The drums first are put into a straightener which takes the kinks out by water pressure (80 pounds hydrostatic). If it is then decided that the drum is worth saving, it is washed with a caustic soda solution, cleaned with water and dried by air at 170 degrees temperature. Six drums can be cleaned at a time and the process takes only about five minutes. After cleaning, the drum is checked by air for leaks and gets a new coat of paint.

According to Lieut. Young, rejects are less than one out of 10 and even the rejects are put to some use, such as asphalt storage. The best luck so far has been with 16-gauge drums, and the Lieutenant figures that the Navy will profit by the reconditioning operation to the extent of getting at least one more trip out of each drum that goes through the process.

Lieut. Young had been with Frontier Fuel for 10 years at the time he entered the Navy, and before that saw service with Pure, Tide Water and The Texas Co. He has been in uniform since the Spring of '42, and out here about 20 months.—H. A. Y.

the Naval Fuel Annex, and their work involves much the same duties as those connected with the peacetime operation of any "state-side" marine terminal, only the amount of products they receive and issue each day is probably many times greater.

Still another oil man is Lieut. A. J. Young, from Buffalo, about whom more will be told in another story, while others are:

Lieut. Commander John H. Koehler, Naval Supply Depot, Pearl, formerly of Gulf; Pay Clerk C. H. La Flamme, Naval Supply Depot, Pearl, from California Standard at San Pedro; Lieut. (j.g.) C. E. Morse, Naval Air Station, Kahului, from Richfield; Lieut. (j.g.) J. W. Shugart, Naval Air Station, Barber's Point, from Southwestern Petroleum at Fort Worth, Tex.; Lieut. (j.g.) Z. P. Armstrong, Naval Supply Depot, Pearl, from Henderson Properties, Corpus Christi, Tex.; Lieut. (j.g.) J. M. Sprague, Naval Air Station, Honolulu, from Carter Oil Co., Tulsa, Okla.; Pay Clerk J. W. Seitz, Naval Supply Depot, Pearl, from Atlantic Refining; Lieut. R. L. Reeves, District Supply Office, from Gulf; Pay Clerk W. E. Richardson, Naval Supply Depot, Pearl, from Shell at Martinez, Calif.; and Lieut. J. E. Lyon, Jr., Naval Air Station, Kaneohe, from Quaker State at Atlanta, Ga.

Regimentation Chief Handicap On Oil Men, Taylor Affirms

NPN News Bureau

LOS ANGELES — "America's future oil supply is not limited by our ability to find or produce it, but by the cost of doing so, with the added handicaps of a regimented economy supervised by those who do not know the business refuse to recognize realistic conditions of today."

That is a summary of a talk given last week by Reese H. Taylor, president of the Union Oil Co., when he addressed members of the Los Angeles Optimist Club.

Supervise Petroleum Supplies for Civilians in Rome Area

Capt. D. J. Sutcliffe

Maj. J. J. Fagan

Arthur Armstrong

This trio, assigned by the British, is attached to the civil affairs branch, Petroleum Section, AFHQ and passes on petroleum supplies for civilian consumption in the Rome area. Mr. Armstrong, one of the few civilians in the POL service, hails from Surrey, England, while in normal times, Maj. Fagan makes his home on North Circular Road, Dublin, Ireland.

With Warren Platt in Italy

'Gas' Always on Tap, Says Supply Chief of XV Air Force in Italy; Oil Men Keep Lines Full

By Warren C. Platt

(The dispatch following was written by Mr. Platt while he was still in Italy.)

NAPLES, Italy. — Twenty years with the Humble Oil & Refining Co. as a production engineer is the record of **First Lieut. L. A. Feagin** who for the past 18 months has been overseas with the military pipeline group in Italy. He went through the oil pipeline school at Claibourne, La., though an old pipeliner himself. His last home was at Odessa, Tex., but his present home address is San Antonio.

Capt. L. A. Foy was a pipeliner with the Magnolia Petroleum Co. at Electra, Tex., until he went into the army four years ago. Since then he has been laying pipe with the North African and Italian pipeline battalions.

Lieut. Col. Nelson E. Trumbull was with the Ohio Oil Co., in Michigan for many years until he joined a pipeline battalion and got busy laying line in North Africa and Italy. While he is overseas his wife is living in Glendale, Calif.

Lieut. Col. Edward C. Gill is a former district manager of the Pacific Gas & Electric Co. He joined the engineers at the start of the war, came to England in July, 1944, and recently was put in charge of a military pipeline battalion in Italy. His last station as a civilian in the U. S. was at Tracy, Calif. When he first went with the Engineers he was assigned to Atlanta, Ga. He is a graduate of the University of Washington in 1930. He entered the Army as a reserve officer in 1937 and was called to active duty in 1942.

Lieut. Howard R. Holcomb, now in the Engineers as a pipeliner, is a graduate of the University of Oklahoma as a mechanical engineer. He worked for the Consolidated Gas Utilities Corp. at Blackwell, Okla., before joining the Army.

Lieut. Francis Epps, now an engineer over here, was with the Phillips Petroleum Co. at Borger, Tex., where he set the rig for what was then the deepest well in the world.

First Lieut. Robert H. Park is a graduate of M. I. T. as a chemical engineer. He was in the development department of the Texas Co. at Port Arthur, Tex., for three years before getting into the Army. Now he is in charge of a pipeline dispatching station.

Maj. Jerome F. Krastel, second in command of an engineering battalion in Italy that operates the pipelines on the east side, has been a construction and refinery operating engineer for 24 years with Standard of New Jersey. He was born and raised in Baltimore and there worked in the Standard refinery, but most of his time has been spent out of the country, particularly at Aruba.

He went in the army in August of 1942, went through the pipeline school at Claibourne, La., came to North Africa in December of 1943 and was active in all the pipeline construction work over here. When he was at Claibourne the commanding officer called him in and asked him to take charge of a company that "had a lot of prima donnas" in it.

The officer evidently did not think very well of them. Maj. Krastel asked what seemed to be the matter. "They are a lot of crazy oil men" said the "C.O." "Oh well, maybe I can live with them as I am one myself," replied Maj. Krastel. The C.O. answered that he wished him well but he had not known that the major was an oil man when he sent for him. So the major took command and survived the ordeal easily.

Lieut. Col. Edward C. Gill, commanding 600 Engineer Service Battalion

Lieut. Col. C. L. Marshall, chief of supply for the 15th Air Force Service Command in Italy, the air force that flies mainly from the Foggia area, is an oil man but he hasn't thought much about it for several years. (*See NPN, May—p.—*) He was with the Shell at Wood River as a refinery engineer, then went to the Sinclair Houston refinery. After several years there, he returned to the Shell at Houston. He is a graduate of Texas A & M in chemical engineering in 1930. (If all the Texas A & M boys ever got together they would make a real army in themselves.)

While Col. Marshall has gotten a bit away from the oil business in recent months, nevertheless a large part of the supplies that he is responsible for is aviation gasoline. He also operates some 28 gasoline dumps. He says that there never has been a time when his air force has not had all the gasoline it needed to get the day's assignment done, and they are a long range outfit. The newspapers of late tell of this XV Air Corps flying up into Austria and Germany. Because of the pipelines on the eastern side of Italy, he says he has been able to reduce stocks half and still keep the planes well supplied.

Started in the Ranks

An oil equipment man from out in Kansas is **Capt. H. R. Nincehelser.** He now has command of a company operating the pipelines in Corsica. He was born near Abilene, Kans. and for some years worked for the Continental Supply Co. at MacPherson, Kans. He went into the Army as a private in 1940 and has been a captain for a year. He has been around the "Med" in all the campaigns there.

Staff Sgt. Claude Bertrom comes originally from Olean, N. Y. He has worked on drilling rigs in Illinois and Oklahoma and done drilling contracting in Michigan. He is now in a gasoline supply company that runs cans and drum dumps in Italy.

Capt. James W. Gallagher of Tulsa, petroleum liaison officer, Fifth Army

Maj. Charles D. Peterson serves in the Rome office of POL

First Lieut. Alston B. Barrow we have to thank for a lot of fine photographs. In addition to being in an engineering company he also is an amateur photographer of real skill. Back home he lives at Baton Rouge, La. He has been a consulting geologist and engineer. His last work was at Grayville, Ill. He worked for the Superior Oil Co. of California and also for William M. Keck of that state. He was born in St. Francisville, La. and graduated in petroleum engineering from the University of Louisiana. He, too, went to the oil school at Claibourne, La. and arrived in Oran, North Africa with a POL company in September of 1943. He came to Italy and operated the pipeline to Rome. He was bombed in Naples and blown against a wall.

Two oil men from Texas are now in POL in North Africa. They are **Capt. H. G. Harber** of the Humble's production department and **Lieut. J. B. Latham** of the Texas Co. pipeline department in the Panhandle.

Capt. James W. Gallagher, POL liaison officer for northern Italy, is an old Standard of New Jersey production man. He went with the Carter Oil Co., in Illinois in 1921, handling its oil field equipment. Then he was transferred to Tulsa and in 1939 to Venezuela. When the drilling activity there dropped because of the war the captain joined the Army and has been around the Mediterranean fighting area ever since.

Served in Mexico

Another Standard of New Jersey foreign department man is **Maj. E. C. Borrego,** who is the petroleum officer to the Allied Control Commission at Rome. He studied petroleum engineering at the Colorado School of Mines class of 1926. He served Standard in Mexico for 11 years, but when the company's properties were seized by the government in 1939 he was transferred to South America. He was the last oil man to leave Mexico. He joined the Army in 1943, as a captain and was promoted to major in April, 1944.

Also in the Rome office of POL is **Maj. Charles D. Peterson,** former New England sales manager for Richfield Oil Co. He is a graduate of Harvard, 1932, and has been in the oil business ever since, specializing on lube oil engineering. He went into the army in 1940 as a lieutenant, was transferred to AFHQ POL Section in January 1944 and was promoted to major last December.

With POL on Civil Affairs in the Rome office is **Lieut. Col. John L. King,** for many years with the Pennzoil Co. at Oil City, Pa. He went to Pennzoil not long after spending three years at Carnegie Tech. He was a reserve officer. He went into the Resources Division of the Services of Supply in April, 1942; then to the newly organized Fuel & Lubes section of the Quartermaster's Department in July of 1943 and then to POL of AFHQ in Civil Affairs in October of 1943.

It is now **Lieut. Col. Coleman Romain** of the POL office of southern France. He is an automobile man from New Orleans. His promotion from major came the other week.

Greater Well Drilling Urged by Davies

NPN News Bureau

WASHINGTON — Deputy PAW Davies said this week that it "would be desirable" to increase the 1945 program calling for drilling of 5000 wildcat wells "as rapidly as materials and manpower become available."

He made the statement in announcing that more than 400,000 bbls., or 40% of the total gain in daily U. S. crude production since Pearl Harbor, is attributable to wartime exploration and development of reserves discovered in this period.

"Despite the termination of the European war," Mr. Davies said, "military and essential civilian requirements for petroleum products will remain at a level that will necessitate operation of the nation's oil fields at or above their maximum efficient rate of production. Consequently, the search for new fields and pools must be pressed at the maximum level consistent with available materials and manpower in order to offset the tremendous drain of the nation's known crude oil reserves."

On the basis of preliminary estimates, Mr. Davies said that the more than 400,000 barrels now being produced daily from sources discovered since the beginning of the war are divided among PAW's districts as follows:

Dist. 2	200,000 bbls.
Dist. 3	155,000 bbls.
Dist. 4	12,000 bbls.
Dist. 5	35,000 bbls.

Washington—By Herbert A. Yocom

Did Biddle Have Truman's Approval for Filing Title Suit?

WASHINGTON—Speculation as to whether Attorney General Biddle did or did not have the President's approval when he filed the submerged lands title suit is all pretty meaningless, now that the matter is in the courts.

Mr. Yocom

The fact is, however, that the President and Biddle discussed the then-proposed suit at a White House conference on May 16 at 11:30 A.M., and that Biddle told Truman on that occasion that he had concluded a court test should be instituted without delay. Mr. Truman is said to have replied that if that was Biddle's conclusion, why to go right ahead, by all means.

Whether the matter still rested that way when Biddle took his leave of the President is not quite clear, for one report has it that after the Chief Executive agreed to the court action, Biddle then suggested that he might do well to consult with other of his advisors as to the wisdom of, or necessity for the move. Mr. Truman may or may not have done this, but the fact remains that the suit was filed on May 26—just 10 days after the White House conference—and that Biddle stated that the action was instituted "with approval of the President."

* * *

Oil men here are wondering what Deputy PAW Davies would do if President Truman should oust Secretary Ickes from the Cabinet, which is something that could and MAY HAPPEN within the reasonably near future. A good guess on that score would be that the Deputy would first want to take a good long look at the situation, then base any action of his own on a personal appraisal of his possible effectiveness under whatever new arrangement might be made by the President. This assumes, of course, that Mr. Truman would want Mr. Davies to continue on in the government oil setup, for, like Ickes, he too serves "at the pleasure of the President."

* * *

Whether it be due to the cleverness of the Russians, the ineptness of our own State Department, or a combination of both, PAW has been trying unsuccessfully for weeks and even months now to wangle passports out of the Department for American oil men anxious to get into Romania, Poland, Austria and Hungary.

* * *

The PAW effort has been as constant as it has been unavailing, and the exchange of correspondence that has taken place since way back last September is reaching voluminous proportions. Meanwhile, with consent of the Russians, obviously, British oil men already are on the ground in Romania looking out for British interests and it would surprise no one here if they were not also by now in the other three countries.

Reported excuse of the State Department for its failure to date to grant passports is that the countries involved are still under control of the military. That, of course, is all a bit silly, and tends to support the suspicion that this is just another example of the ineffectiveness of the one branch of government to which all American businessmen are supposed to look for protection of their legitimate interests abroad.

Question of the possible present use and post-war future of Germany's synthetic oil industry is being studied by a special committee appointed by the Foreign Economic Administration and chairmaned by Deputy PAW Davies. In view of the large demands for oil to fight the Jap war, one possible outcome is a committee recommendation that the Allies make maximum use of the synthetic plants between now and VJ-Day, then junk them so that they can't be used again by the Germans to support any new dream of world conquest.

Only complication encountered by the committee in its study thus far arises from the fact that the synthetic industry is largely concentrated in eastern Germany, which means that the Russians are in control. The Reds, it seems, aren't too anxious to let the committee's American experts have a good look-see, and a reason could be that they have plans of their own which would preclude any Allied use of the industry in the war against Japan.

ODT has asked the Federal Loan Administration to finance construction of 500 pressure-type tank cars for movement of 100-octane components, mainly to new plants due to go on stream this year, but the Army is balking.

* * *

That threat of a submarine blitz, which President Truman says was intended to hit the East Coast in April, prompted a temporary PAW revision of the May supply program to allow for an 80,000 b/d cut in tanker deliveries to District 1.

Atlantic Coast—By Frank P. S. Glassey

Dealers To Lean More Heavily on Suppliers, Survey Shows

NEW YORK—Service station operators after the war, while retaining their semi-independent status, are going to lean increasingly toward their major supplier—not only for petroleum products, but for automotive accessories and for guidance in running their business.

Mr. Glassey

This is one conclusion that can be reached from the results of a recent survey conducted by Sinclair Refining Co., which queried more than 5000 dealers and received detailed returns from 1670. Sinclair itself has published no general observations based on the replies to its questionnaire, but an independent analysis of trends shown by those reporting indicates a growing dependence on the primary supplier.

One of the most significant questions concerned the dealer's preference as to his source of automotive merchandise after the war. The question read:

"If you could make arrangements through Sinclair to get most of your stock of tires, batteries, and accessories in this way—would you prefer such an arrangement, rather than buying through several suppliers—assuming, of course, that quality, buying prices and terms were equal?"

Eighty-four percent of the Sinclair dealers answered that they would prefer to buy their TBA items from Sinclair, while only 16% would rather obtain them from other sources. This would seem to mean that the major oil companies will widen their field of distribution during the next few years.

Dealers obviously intend to carry a greater number of items in the future. Thus 70% of dealers are handling tires now, but 99% said that they intend to sell them after the war. Eighty-eight per cent are now handling batteries but 98% plan to do so after V-J Day.

Of the replies tabulated, 96% reported that they are already handling such accessories as fan belts, spark plugs, light bulbs, etc. This would seem to indicate a substantial increase over similar merchandising before Pearl Harbor, to add to service station dollar volume. The average dealer sells 55 such items, and those who hope to extend their line suggested, on an average, 57 additional items.

Only 4% of the reporting Sinclair dealers said that they are now handling home supplies such as mops, stepladders,

wash baskets and brushes, but 56% revealed that they hope to do so after the war.

Dealers who are still in business appear confident that their postwar future will be profitable, for 96% expressed optimism regarding future earnings. Three-quarters said they wish their stations put in better condition and the same proportion plan to improve the appearance of stations. Almost all said they will need additional help after the war. The average dealer reported only two employes at the present time and expressed the belief that he will need three more when the war is over.

One of the most interesting sections of the questionnaires returned was that in which dealers were offered an opportunity to air their "pet peeves." More than 500 obliged, and about half of these comments were directed at policies of the major company. The others concerned lack of space and equipment, shortage and quality of help, free service and inconsideration of customers, and Government regulations.

One dealer said that Sinclair "should fix my island which has been promised. The island is all cracked and sunken."

Another complained about insufficient help on service station appearance. A third said that too many company stations are "sloppy and unattractive," and still another urged more speed in supplying Sinclair uniforms for himself and his employes.

Such remarks reflect the opinion, at least of dealers, that the supplying oil company has a definite responsibility for the stations selling its products.

• • •

Recurrent rumors that Standard Oil Co. (N.J.) is planning to enlarge its office space in Rockefeller Center here were heard again last week when building authorities announced that razing of old buildings immediately adjacent to existing skyscrapers in the development will start as soon as more than 100 tenants can move out.

The plot thus cleared will consist of a 16-story store and office building which will be erected at a cost of $1,750,000 as soon as Government priorities permit. One radio commentator said this will be known as the "Standard Oil Building" and will house all the Jersey Standard offices. To which a company spokesman replied that "this is all news to us. We have no such plans at present."

• • •

Standard Oil Co. of California wishes some of the credit for development of the incendiary bombs now being showered on Japan almost daily. Much of the work that preceded the bomb now used by American airmen was done at Jersey Standard laboratories, in co-operation with Army and Navy experts.

California Standard asserts, however, that it is "the nation's largest producer of a jellied lubricant," and that its research experts have aided in the development of the new weapon for four years.

"The success of the incendiary material," the company said, "is largely based on the peculiar properties of California crude oil. Because of this, Standard of California is the nation's largest producer of the crude oil used in the incendiary bombs and one of the nation's biggest manufacturers of the jelly compound.

PIPELINES — NPN Writers at Three Vital Points Discuss the Industry's problems

Midwest—By Earl Lamm

Tank Wagon Price Reduction Viewed as Market Demoralizer

CHICAGO — Some oil marketing feathers are still ruffled over a recent reduction in the tank wagon price for gasoline in a small area of east central Illinois around Monticello and Pontiac, where the major company market setter "met competition" by eliminating the 1.5c differential between the consumer tank wagon and dealer prices.

Mr. Lamm

In normal times, the resulting market disturbance probably would resemble a pebble thrown in Lake Michigan, but coming as it did so close to V-E Day, it sparked a whole pinwheel of possibilities in the minds of both independent and major marketing men, who see in it an alarming fore-runner of a demoralized market. It is nothing new that a farmer can have small quantities of gasoline delivered to his home several miles out as cheaply as a dealer, or service station operator, can buy it in town in quantity lots, although it obviously is not normal good business.

Important thing is that price reductions are unusual when the general tone of business is toward increases and feared inflation. The flurry of rumors that persist seem to illustrate the confusion in the industry incident to conflicting official government statements and industry opinion. PAW and other government agency statements are extremely conservative in the belief of many industry men, who seem to actually feel that the Jap war may end very suddenly although they may never make such an optimistic statement.

Perhaps such opinion is rooted in the act of President Truman, who has asked Congress to authorize $25 weekly unemployment pay for six months. This was a sudden and decided step to the left by the President, who most Middle Westerners felt had been using a middle buster in cultivating his political field.

What was the reason for this sudden turn? Did the President see a sudden finish to the Jap war with early cancellation of all war contracts and wholesale unemployment? If the Jap war continues for another year or so, gradual reconversion of industry and the heavy demand for civilian goods will enable the country to absorb all V-E Day cutbacks with only minor unemployment of all able bodied men anxious to work.

The oil industry may be said to occupy a high seat beside war plant workers, for if the Jap war should end suddenly (and everybody hopes it will), predictions are that there would be "mass under-consumption" of gasoline. Hence, nerves are jumpy, and many things are being read into what ordinarily would be a minor market disturbance.

One observer, perhaps rightly, merely saw in the price reduction the beginning of an effort by major oil companies to fore-stall the early postwar loss of a large volume of farm business as soon as rationing passes, especially "R" coupons. His theory was that whether or not there is a lot of shifting about of "R" coupons, either in or on the edge of the black market, rationing has created a false bottom for certain suppliers, who will lose that business when the false bottom is kicked out and they are anxious to begin adjustments.

This belief is supported by reports that since cancellation of PAW restrictions some 90 days ago, the big companies are buying up and giving away to farmers numerous skid tanks for storage. Independents do the same things, but say they are not financially able to match the pace. Gratis supplying of equipment is of course a form of price cutting.

• • •

Some independent oil marketers think it would be a good idea to support the Ellendor Bill, which has been pending in Congress for some time, and advocate its extension to cover the separation of oil marketing from other branches of the industry as well as divorcing tire marketing from tire manufacturing.

• • •

No figures are available at OPA or PAW here so far showing just what the net effect of the increase in "A" and "B" card gasoline rations, effective this month, will be. According to PAW, 140,000 b/d was allocated for that purpose, being a 10% increase on the current consumption of approximately 1,400,000 b/d of civilian gasoline; but consensus of refiners looking for their share in the sale of the increased amount, is that it will be only 5% increase over all.

Davies Tells House War-Oil Job Grows Bigger With Germany Out; Cash Is Speeded for PAW

NPN News Bureau

WASHINGTON—The fact that the war-oil job is growing bigger, even with Germany out of the struggle, resulted in a report to the Congress this week that the work of PAW "cannot be expected to reduce until the end of the Japanese war."

The report was presented to the House by its Appropriations Committee after hearing Deputy PAW Davies testify that the oil job is assuming "larger proportions and greater complexity" than ever before. Petroleum operations, he said, "must continue to be planned, coordinated and centrally directed—more so, in fact, in the months to come than over the period we have gone through."

Accepting the Davies' statement in full, the Appropriations Committee recommended that PAW be allowed all but $31,800 of a requested $4,000,000 fund to finance operations on a one-war basis through the fiscal year ending June 30, 1946.

"The great distances involved in the war in the Pacific," the committee informed the House, "require such large amounts of gasoline and other petroleum products that the work of the Petroleum Administration cannot be expected to reduce until the end of the Japanese war."

Praises PAW Record

The committee praised the job done thus far by PAW, asserting that the oil agency "has accomplished the seemingly impossible in stretching our oil supplies and finding additional new sources of supply to meet the staggering requirements of war, at the same time meeting minimum civilian needs." It also noted with "gratification" the "financial success" of the Big Inch and Little Inch pipe lines, which were sponsored by PAW, and commented: "These two lines, if properly utilized, will be of service to the country for many years after the war."

The small cut made in the PAW money bill is to come entirely out of funds asked by PAW to meet penalty mail and travel expenses and represents a reduction of 10 per cent in amount estimated necessary for those purposes.

The PAW appropriation was included in the National War Agencies Appropriations Bill for 1946—a bill the committee said "marks the beginning of the end of those agencies established during the war to develop and maintain the war production machine, to furnish the necessary civilian assistance to the armed forces and to adjust the civilian economy to wartime necessity."

The committee, in its report, recommended easing and lifting of government controls and restrictions, together with liquidation of various war agencies, as rapidly as war conditions permit, to echo a hope voiced by Mr. Davies in earlier testimony that this would mark his last appearance before the appropriations group.

"Our hope that we may not appear again," he said, "springs solely from the desire we share to have the war over, liquidate the war organization and get back to our peacetime pursuits."

Later on in his testimony, Mr. Davies said his own guess was that "we ought to be able to wind up affairs of the agency within three months following the termination of the (Japanese) war."

In answer to a question of Rep. Ludlow, of Indiana, he said PAW would be eliminated "very speedily" when the war ended.

Highpoints of testimony given committee by Mr. Davies and other PAW officials included:

1. Foreign oil production "with Russia always excepted because of our limited knowledge as to the Russian situation" is running at about 1,600,000 b/d. This is 38% above the prewar level, compared with a domestic production rate in the U. S. 35% above prewar.

Foreign Oil Critical

"What we should have done without this foreign oil during the war period, I do not know," Mr. Davies told the committee. "The production of the United States could not have supported the colossal military operations of the United Nations. We have been clearly dependent in a large way upon foreign oil—a fact which we should never forget and which should suggest to us in very definite way the need for an international oil policy which will secure these resources for the future."

2. Total supply of oil available to the United Nations in 1944 as a group, including Russia, was 6,887,000 b/d.

3. Venezeulan production last year averaged about 700,000 b/d and is now "something like 850,000 b/d." Production in Iran was about 278,000 b/d and is now about 350,000 b/d.

4. U. S. production of 100-octane averaged 390,000 b/d in 1944 and is now above 500,000 b/d.

5. Total available refinery plant capacity in the U. S., South America and the Middle East, as of Jan. 1, 1945, was about 7,400,000 b/d.

15,000,000 Bbls. for Russia

6. Davies' "offhand" estimate is that the Allies have shipped "something like 15,000,000 bbls. of oil" to Russia, and also "large amounts of oil refining machinery."

7. If the Jap war continues for a full year after the end of the European war, pipelines to the East Coast will have to be kept filled "because we are faced with a continuing shortage of petroleum transportation."

8. The "basic factor" influencing PAW's post-VE Day activities "is that military requirements for petroleum products are more than 200,000 b/d larger than present production (as of May 1) for the European and Far Eastern wars. In other words PAW is in the peculiar position of having to supply more, rather than less, products after VE-Day."

9. If requirements of the war program are to be met, foreign crude production will have to be increased to about 1,950,000 b/d by the end of 1945.

10. PAW now has 27 men in Germany examining synthetic oil plants for the purpose of determining "whether they have developed any new ideas that are not known to us."

Ask Congress for $2,000 To Make PAW a Host

NPN News Bureau

WASHINGTON—If Congress goes along with a recommendation of the House Appropriations Committee, PAW is going to be able to spend $2,000 in the new fiscal year starting July 1 for the entertainment of visiting foreign officials.

Language permitting expenditure of up to that amount for that purpose was included by the Committee this week in the PAW Section of the National War Agencies Appropriation Bill. Deputy PAW Davies had explained earlier that PAW's object was "to reciprocate in kind for hospitality" shown PAW officials when they are sent abroad.

WAR OIL NEWS from WASHINGTON

HERBERT YOCOM *Bureau Chief*

NATIONAL PRESS BLDG.

NATIONAL 3477

Rail Movements To Eastern Seaboard Take Big Dip

NPN News Bureau

WASHINGTON — Transfer of tank cars to swell the flood of war supplies to the Pacific Coast caused rail movements of crude oil and petroleum products to the Atlantic Seaboard last week to fall 37,304 b/d below those of the preceding week, Deputy PAW Davies has announced.

For the week ending May 26 tank car shipments to the East Coast averaged 505,783 b/d, lowest since the week ending March 10, 1945. They compared

with an average of 543,087 b/d during the week ending May 19, 1945, and 726,523 b/d for the week ending May 27, 1944.

The East Coast stock position will also be adversely affected by the loss of production at the Gulf Refining Company's plant in Port Arthur, Texas, which was closed down for the last 5 days by a strike, Mr. Davies said.

The oil industry and PAW meantime are faced also with the new transportation and other problems resulting from the present phase of the war program, Mr. Davies said, adding that "everyone engaged in production or distribution of petroleum and petroleum products will have to work with unceasing energy to maintain the high levels required by military and other essential users and to make available to civilian motorists the greater allocations that have recently been announced."

West Coast movements are scheduled to increase steadily for the next few weeks, and the change-over may result in further decline in tank car deliveries to East Coast points. When operating difficulties incident to the new movements have been overcome, however, East Coast shipments are expected to level off at an average of about 525,000 b/d this summer.

Crude oil was delivered through the "Big Inch" (24-inch) pipeline to East Coast refineries at the rate of 306,914 b/d last week compared with 231,294 b/d the previous week. The decrease, it was announced, resulted from diversion of military gasoline to storage along pipeline.

Witnesses Aligned for Oil Supply Inquiry

NPN News Bureau

WASHINGTON—Chairman John M. Lovejoy of the Petroleum Industry Committee concerned with preparing testimony on sources of oil supply for hearing before Senate Special Oil Committee has announced completion of tentative plans for presentation by its witnesses.

Four phases of petroleum industry problems programmed for discussion and men slated to handle discussions are:

1—Location and extent of oil and gas reserves in U. S.—J. Edgar Pew, Vice-president, Sun Oil Co.; Monroe G. Cheney, President, Anzac Oil Co.; E. L. Degolyer, Consulting Engineer.

2—Conservation and technology procedure and problems—Chairman Lovejoy, President, Seaboard Oil Co.; M. C. Haider, Production Reserve Engineer, New Jersey Standard; J. C. Hunter, President, Mid-Continent Oil & Gas Assn.

3—Taxes and price factors affecting exploration and production of petroleum —Chairman Lovejoy; F. B. Plank, Tax Commissioner, Cities Service Oil Co.; Walter S. Hallanan, President, Plymouth Oil Co.

4—Public lands in relation to petroleum—A. C. Mattei, President, Honolulu Oil Corp., and witnesses to be selected.

Reciprocal Trade Bill Resistance Gains

NPN News Bureau

WASHINGTON—Strong opposition to the Administration's reciprocal trade extension bill developed in Senate Finance committee this week, and it appeared that President Truman might have to bring personal pressure to bear to save the measure.

Main center of the fight against the measure — which moved unchanged through the House, despite vigorous Republican challenge—is Sect. 2, which would empower the Administration to cut tariffs another 50%, bringing the duty on oil down to one-eighth of a cent a gallon if it so desired. Committee members were reported opposed to that feature of the bill by a 3 to 2 margin.

The real showdown is not expected to come, however, until the extension legislation moves to the floor, where the Administration will be in position to muster its full strength.

Evidence of the strategy of the opposition was displayed, meanwhile, with offering of two amendments by senators determined at least to minimize the effect of the tariff-cutting section on domestic interests should they fail in efforts to kill the proviso outright.

O'Mahoney Asks Review

One, offered by Sen. O'Mahoney (D., Wyo.) would provide for Congressional review of all reciprocal trade pacts within 60 days after negotiation. The other, offered by Sen. Bailey (D., N.C.) and sponsored by Sen. Johnson (D., Colo.) in Bailey's absence from the capital, states: "No proclamation shall be made pursuant to this section decreasing the duty or other import restrictions on any mineral or metal included in the current list of strategic and critical materials approved by the Army and Navy Munitions Board, Nov. 20, 1944 . . ."

Petroleum and its products are included in Group C of that list, which defines strategic and critical materials as "those materials required for essential uses in a war emergency, the procurement of which in adequate quantities, quality and time is sufficiently uncertain for any reason to require prior provision for the supply thereof."

Witnesses before the Senate Finance committee this week included Russell B. Brown, general counsel of the Independent Petroleum Association of America, who testified that the only oil firms interested in slashing oil tariffs were the majors who produce abroad.

"Let it be remembered," he admonished the committee, "that there is no domestic oil producing industry in Venezuela, in Colombia and Peru, which are sources of imports in the Western hemisphere, and no domestic producing industry in Iraq, Saudi Arabia and Kuwait in the Middle East."

Pointing out that those who would export from these countries are the "Standard" companies, particularly Jersey Standard and Socony-Vacuum, together with Gulf, Sinclair, Texaco and Shell, Brown told the committee: "To discover oil in the United States we must use oil refined in the United States."

"Discoveries are made with funds from the sale of oil," he continued. "None will be made under prices that afford no incentive, nor under inadequate income from severely restricted market outlets for crude oil."

Asked by Sen. McMahon (D., Conn.) how it was that oil firms seemed to be making so much money, Brown replied that a few major, integrated firms were doing well but that about 25% of the independents had been forced out of business in recent years.

Tideland Title Issue Hearings Set June 18

NPN News Bureau

WASHINGTON—The tidelands title issue this week turned into a favorite topic of speculation in the nation's capital and received lengthy attention from Secretary Ickes at a press conference while the House Judiciary Committee prepared to start hearings June 18 on resolutions which would vest firmly in the states title to their respective coastal lands.

Course of action before the Senate Judiciary subcommittee recently set up to consider S. J. Res. 48, identical in scope with the House measures, was uncertain until the return of Sen. Pat McCarran of Nevada to Washington this week. However, two reports from executive departments—Interior and State —were on file with the Senate group.

The State Department report carefully parried the question of what that agency thought of Sen. McCarran's quitclaim resolution. Acting Secretary of State Joseph Grew wrote that the matter appeared to relate primarily to a domestic question of the respective extent of state and federal rights, so would not appear to fall within the purview of the State Department's activities. He suggested that other government agencies were in a "better position" to furnish what he called "helpful suggestions" with respect to the resolution.

Ickes Urges Decision

In his report to the Senate subcommittee, Mr. Ickes wrote that the question is a "legal" one of "great importance" and supposed that it ought to be settled by the courts as he has urged "for years." However, he pointed out that there was a subsidiary issue of particular importance to the Interior Department—the question dealing with lands held in trust by the federal government for Indian groups or individuals.

Some of these tracts include submerged lands, he pointed out, and since the Indians affected actually own the

interest in them, Mr. Ickes suggested that S. J. Res. 48 be amended to exclude lands "beneath tidewater and such lands beneath navigable waters as are held by the United States for the benefit of any tribe, band, or group of Indians or for individual Indians."

At a press conference on May 31, however, the Interior Secretary devoted fifteen or twenty minutes, all told, to the submerged-oil-lands issue and at one point, as casually as one would pick an apple from a tree, popped the name of Edwin Pauley into his tidelands monologue.

Mr. Ickes prefaced his Pauley remarks with the statement that the federal government's suit asserting title to submerged lands off the California Coast was an "absolutely impersonal" procedure "so far as this department is concerned, and I am sure, so far as the Justice Department is concerned."

'No Particular Individual'

Following persistent questioning on various angles of the submerged oil lands question, Ickes briefly summarized his interest, going as far back as 1937, asserting that his recommendations "were taken without reference to any particular individual."

Without pausing, he added that "as a matter of fact, I never met Mr. Pauley (Edwin W. Pauley, prominent West Coast oil man now American member of the Allied Reparations Committee in Moscow). I didn't know there was a Mr. Pauley. I didn't meet him, as far as I can remember, until late in 1939 when I was in California to make a couple of speeches in behalf of the Oil Conservation Law which was being voted on by referendum."

Asked what prompted him to mention Mr. Pauley's name, Ickes said he had done so because Pauley's name had appeared in some newspaper reports on the tidelands affair, adding that he did not know "what interest he has, if any. I don't know a thing about it. I couldn't say off hand who has any interest. I have heard one or two oil companies mentioned whose names I don't recall."

Cities Service Gets Gas Line

NPN News Bureau

WASHINGTON — Cities Service Gas Co., Oklahoma City, Okla., this week was authorized by Federal Power Commission to acquire and operate the 231-mile Hugoton natural gas pipeline.

By acquiring the 26-inch pipeline from its affiliate, Cities Service Transportation & Chemical Co., the order states, Cities Service Gas Co. will improve its financial condition, effect operating economies and simplify operations. Facilities to be acquired include the pipeline extending east from a point near Guymon in the Hugoton gas field, Texas County, Okla., to Cities Service Gas Co.'s Blackwell compressor station and dehydration plant at the line's western terminus, and appurtenances.

Calls Small Refiners For New Sharing Of U.S. Royalty Oil

NPN News Bureau

WASHINGTON—The Department of Interior this week adopted a new policy under which it will take public lands royalty oil in kind and give small refiners, short of crude, first chance at it.

The action, taken in part 221, chapter II of Title 30, was an adoption, practically in toto, of the principles of S.680, recently introduced in the Senate by Sen. O'Mahoney of Wyoming, which would amend the General Leasing Act to grant preferences in the sale of royalty oil to refiners who do not have their own sources of crude supply.

Under the new policy, refiners may file an application with the Secretary of the Interior to obtain royalty oil, if they cannot obtain crude on the open market. The application must be in triplicate and accompanied by a detailed statement containing the following information:

1. Capacity of refinery and amount, source, and grade of all crude currently available to the applicant refiner.

2. "Factual" data concerning existing refinery commitments, among other things indicating "precisely" to what extent the products are either sold under war contracts or tend to facilitate the successful prosecution of the war.

3. Minimum amount and grade of additional crude needed to meet refinery commitments, field or fields which refiner believes offer a potential source of crude supply because of proximity to the refinery, and the available transportation facilities which the refiner proposes to utilize.

4. A tabulation for the preceding 12 months of the amount (in b/d) and grade of crude refined each month and the kind, grade and amount of finished products; also an estimate of the total refinery through-put for the next succeeding year.

When such an application is received, the Geological Survey will turn over one copy to PAW, whose recommendations regarding war products manufacture and transportation-use will be taken into consideration in advising the secretary regarding disposition of the application.

When the department takes its royalty oil from public lands leases in kind, it will advertise it for sale at not less than the market price or at the maximum price established or authorized by OPA, if it is greater. When two or more identical bids are received for the same crude, "the secretary," the new order states, "will give due consideration to the factors outlined (above) and award the oil to such bidder as he determines would best serve the public interest."

The most ticklish question will arise when several "small" refiners bid the same OPA maximum price, and this will probably be examined from the standpoint of which refiner would use transportation most efficiently, plus the factor of war products manufacture.

Interested refiners should address inquiries to the Supervisor of Oil and Gas Operations, Conservation Branch, Geological Survey, at the city nearest them, for information on amount and quality of royalty crude available from nearby public lands. These supervisors are situated in Tulsa at 239 Federal Building; Roswell, N. M. at 332 Federal Bldg.; Casper, Wyo. at 305 Federal Bldg.; Los Angeles at 533 Post Office and Courthouse Bldg.

During 1944, total production from public lands was 54,439,008 bbls. The government's royalty quantity was 5,837,274 bbls., or about 16,000 b/d, of which it took about 7,000 b/d "in kind" which was sold either at private sale or to the highest bidder—more frequently the latter.

U. S.-British Oil Pool To Be Discontinued

NPN News Bureau

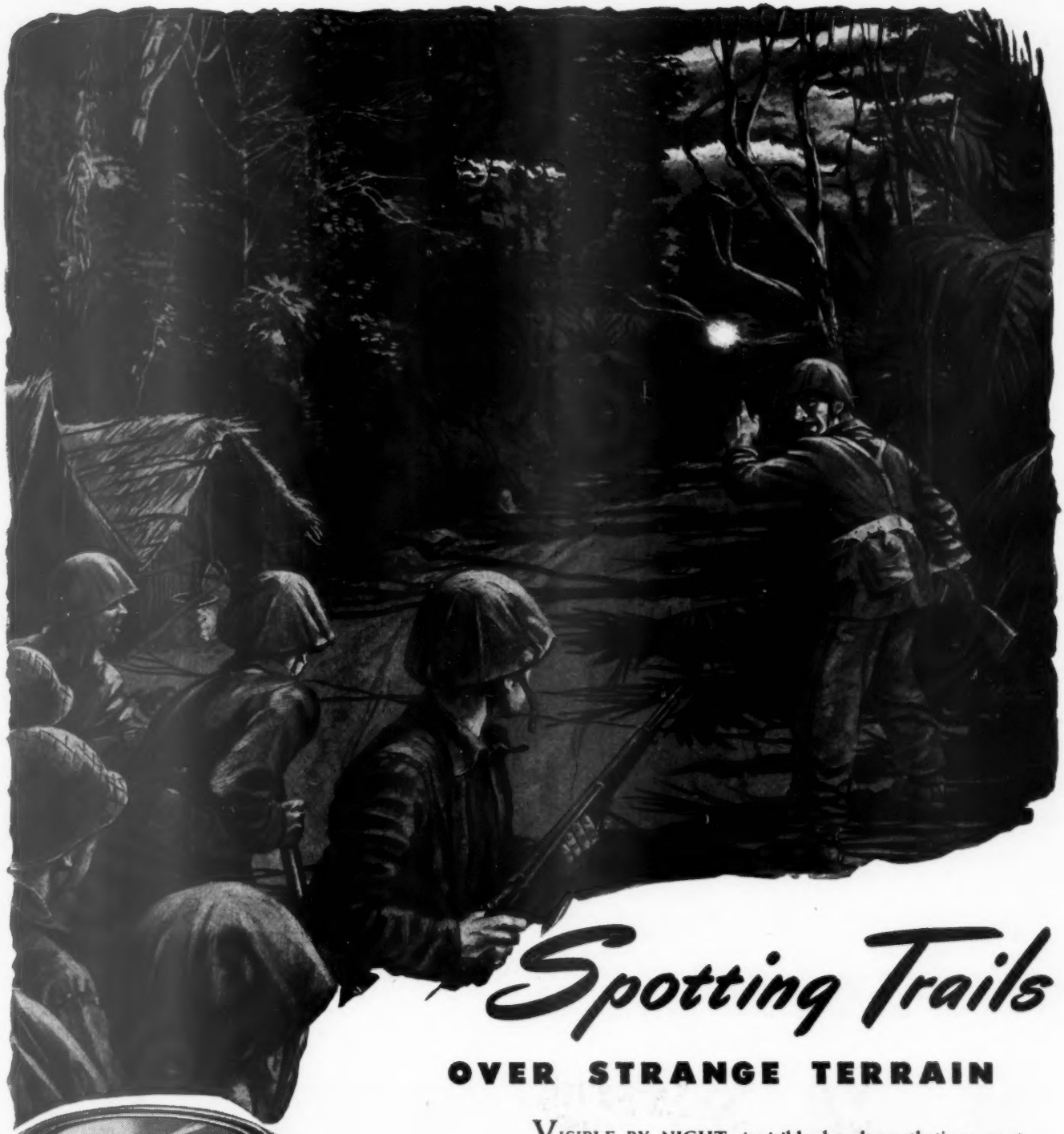
WASHINGTON—The practice of supplying U. S. military forces in the European theater of operations out of a common United Nations pool of lend-lease oil is being discontinued for all except U. S. units still in the British Isles.

The fact that the present supply arrangement, under which the U. S. has been lend-leasing oil to the United Kingdom and then getting back about 50% of it for use of American air, ground and naval forces based in Europe, is to be dropped almost completely was disclosed by the Budget Bureau in presenting a Presidential recommendation that Congress appropriate only $1,975,000,000 for the defense (lend-lease) aid program in the new fiscal year starting July 1.

The money request was $1,563,869,000 under that for the current year, and the reduction reflects, among other things, a recommendation that petroleum products for United States military use should henceforth be financed from war and navy appropriations.

If Congress agrees—as it is expected to do—all shipments of oil products to consuming U. S. units in the European theater outside the United Kingdom will be made direct by Army and Navy starting July 1. The only U. S. forces that will continue to be supplied out of the lend-lease pool will be the small number of troops, plus a few air units, that are to be maintained in Britain.

The chief result of the shift will be the elimination of an awkward bookkeeping arrangement which was necessitated in the beginning by the fact that the British controlled all storage and distribution facilities up to time of the invasion of the continent. Under this arrangement, oil brought in from U. S. and sterling sources was placed in a common pool under British jurisdiction, and U. S. forces then drew on the account as needed, with the British bearing the storage, transportation and other handling costs.



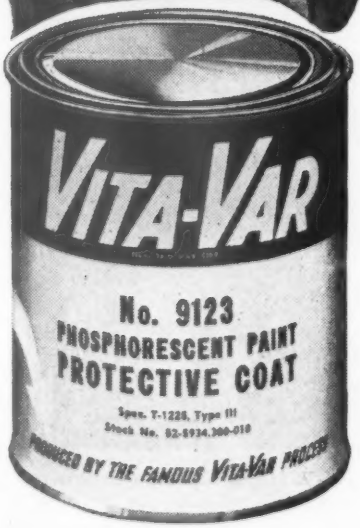
Spotting Trails

OVER STRANGE TERRAIN

VISIBLE BY NIGHT, invisible by day—that's a must for the land buoys planted to guide our armed forces at night through unknown country.

Markers coated with Vita Var Phosphorescent Paint, manufactured by Vita Var Corporation, Paint Engineers, Newark, N. J., fill the bill.

To assure efficient, economical packaging and complete protection for their product, the makers of Vita Var use Crown Cans.



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INDEPENDENT AND HELPFUL

CROWN CAN COMPANY • NEW YORK • PHILADELPHIA • DIVISION OF CROWN CORK AND SEAL COMPANY, BALTIMORE, MARYLAND

What's Ahead on Lessee Rentals? (Third Report)

Veteran Division Manager Urges Firm, Down-to-Earth Policy

Don't Raid Competitors, Recruit Operators From Other Lines, Is Among Suggestions of Man Speaking from 40 Years of Experience

For the past two weeks, NATIONAL PETROLEUM NEWS, has reported results of a nationwide survey on the subject of lessee rentals. First report (see NPN, May 23, p. 19) told how rentals are computed now for over 20,000 leased stations—how they have changed during the war—what equipment oil companies are supplying lessees. Last week NPN reported opinions of oil management men from coast to coast on how postwar lessee rentals should be established.

Now comes the division manager of an integrated oil company who in the accompanying article gives his views garnered out of his 40 years experience in the marketing of petroleum products. He offers no single formula that will solve the problem of lessee rentals postwar but he makes some suggestions that may be applied at leased stations.

If you have ideas on this subject, send them in. Please identify yourself. Your name or your company connection will not be disclosed, if you wish to remain anonymous. Also use the ballot on page 20 to register your vote of the three important questions governing leased stations.

HAVING been connected with one of the larger oil companies for a great many years (more than 40), and having seen the service station business develop from the delivery of gasoline from drums and served through a funnel with a chamois skin into the tanks of the automobiles, to the super-deluxe service stations of today, I have been very much interested in the manner in which the petroleum industry has handled this very interesting development.

In passing, let me say that the oil business has performed an outstanding service to our country and has assisted materially in the development of our wonderful system of transportation by motor in making available in every part of our great country unlimited supplies of gasoline and oil, but probably at a tremendous cost to the industry.

My own efforts in this matter of distribution and sale of gasoline, while confined to only a limited area, have not been without a general knowledge of the trend of the industry in all parts of the country. One frequently hears the expression a thing has gone "from the sublime to the ridiculous", but, in all these years, I have never seen the "sublime" in the matter of service station rentals, and most of the rentals have been "ridiculous".

The fault undoubtedly lies with the sales management in the petroleum industry—the thirst for gallonage on the part of managements, and the weakness of field representatives in urging on management the building of more service stations without the responsibility of producing adequate returns on the investment.

When all else fails, field representatives always drift to the contention that competition forces their recommendation that service station rentals should be reduced because competitors are letting their stations go at an extremely low rental—or no rent at all—and that the field representative can get no competent service station man to take the station at the high rental demanded by his company.

There is, no doubt, some truth in this contention, for most of the concerns in the marketing end of the oil business have been guilty of these practices. But it was "lack of intestinal fortitude" that brought this condition about, lack of demand on the part of management that when investments are made in service stations, they should bring an adequate return on invested capital. This fault lies not with just one concern in the oil business—it is almost universal.

While it is almost vain to hope, there is no *real* reason why the oil industry should not recognize the fact that the distribution and sale of gasoline to the motorist is very much like any other business, whether it be groceries, drugs, or what-not. That when an oil company invests its money in a service station location, and erects a building, they should be able to secure a fair return on that investment. It is the writer's present belief that the oil company is entitled to a return of 4% or 5% on its investment. They should be entitled to a reasonable depreciation on the build-

If the oil company provides the building and the floor space for tire recapping equipment, is it entitled to a return on this capital investment or should the investment be charged to the cost of providing supplemental income for the lessee so that he will stay in the station?

"The Oil Industry's sort of a silent partner—but what a Partner!"

THE Petroleum Industry supplies tremendous amounts of fuels and lubricants to keep the Allied war machine *running*.

But that function is only a final step in the partnership of the military and oilmen.

For example: the mining of the metals that go into a war machine calls for scores of oil industry "assists"—rust preventives, dust-laying agents, and specialized lubricants.

Then all through the fabrication of ore into weapons, petroleum products are indispensable necessities.

We're glad Gulf belongs to this industry.

GULF

READY TODAY WITH THE FUELS OF THE FUTURE

6 Points Suggested on Postwar Lessee Rentals

A vice-president in charge of sales in a Middle Western integrated company offers the following suggestions with regard to postwar lessee rentals:

"The answer to the question as to what rental a supplier should charge his dealer for retail facilities is very simple. The charge should be that amount of rent which the station would bring on the open market. The application of this principle, however, is where your trouble begins. It is difficult to determine the value of any station on the open market.

"The following principles, I believe, should prevail:

"(1) An allowance of free rent at a service station site cannot be justified on any basis. If a supplier also has independent dealers, to turn over a valuable station to a favored dealer places all other dealers at a real disadvantage, to which naturally they have right to object.

"(2) The replacement value or the physical value is not a real measure of what a rent should be. One station may have invested a great amount of money and proved to be a "dud." Another station may have been built at a very reasonable cost, and thereafter become a natural. Assuming that each of these stations cost the same, it would be unrealistic to attempt to charge the dealers the same rental.

"(3) It would appear sound to assume that any station that is worth opening has some value to the dealer. This value would seem to depend upon its inherent ability to attract volume and offer the proper facilities for serving the customers so attracted. Perhaps a test would be what independent dealers will pay for similar facilities.

"(4) Above all, however, once a rental is determined, if a dealer thereafter through his own efforts and diligence builds up an increased volume of business and local goodwill, it is fundamentally wrong in every sense to increase his rent. If the volume increase comes through factors entirely apart from his control or effort, this factor should be a measure of the increased value of the location, and hence justifies an increased rent.

"If, however, the volume grows through the popularity and aggressiveness of the dealer, it should under no circumstances be a basis for increased rent. No supplier who pursues such a policy will long retain many really good dealers. In reality, we are attempting to divide the profits at any location between that which arises directly from the location itself and that which arises directly from the efforts of the dealer.

"(5) Since this appraisal varies from time to time with price conditions, seasonal conditions, competitive conditions, etc., the industry has dodged the difficult responsibility of making a continuously changing rent appraisal and has gone to a gallonage rental as the easiest way out. However, this is not entirely sound from the supplier's point of view, since it reduces the incentive to the dealer to build up volume. A flat rental, if set at the right figure, is the soundest basis for dealer relationship. The dealer then will realize his full margin on any extra volume that he can achieve.

"(6) In hectic periods like these, some combination of a flat rental and a gallonage basis has become general practice.

"In conclusion, the important thing is to charge the dealer exactly the value of any facility, no more, no less."

ings. They should be entitled to a recovery of the amount of advalorem tax and license fees they pay, and they should set up a reserve for maintenance. If an individual were building a service station for another individual he probably would not make the investment without a return of this kind.

Oil Products—Primary Interest?

The oil company primarily is interested in the sale of gasoline and oil. If they ever let this get out of balance, and the trend is that way now, then the rental on a gallonage basis will bring little return.

The building of super-service stations is not primarily for the sale of gasoline and oil, the super-service station is largely built to take care of merchandising items and services which bring little, if any, return to the oil company. Therefore, this lack of return of rental based on the sale of gasoline must be compensated by rental based on investment.

One of the thoughts frequently expressed in connection with the building of service stations by the oil industry is that the oil company makes a profit on the sale of its products. Therefore the service station is merely a facility to promote the sale of these products and any return received as rental is just that much to the good. The policy of rentals based on 1c a gal. on the sale of gasoline probably grew out of this fallacious thinking. It is just another one of the easy methods prevalent in the oil business to satisfy the demands of management for some kind of return on its investment.

It is an easy way on the part of the field people to satisfy the dealer operating the station and to collect the rental at the time of delivery. In other words, a painless method of collecting rent. But it has little, if any, bearing on the rental value of the station for the reason that one dealer may specialize in the sale of gasoline and give the oil company a fairly good return on its investment while another dealer may devote most of his effort to the greasing and washing of cars, service and sale of batteries, or he may be the biggest tire dealer in the community, all of which in most instances brings very little if any return to the oil company.

Good Locations Worth More

Even in such cases where the oil company may be the distributor of the tires and certain of the other merchandise, they are entitled as dealers in these other products to a reasonable profit on such sales and such profits should not be used to carry any part of the rental of the outlet.

The larger oil companies, and many of the smaller ones, maintain as a part of their organization men who are presumed to be expert in the selection of service station locations. Traffic flows are studied and numerous other factors are given consideration. The final selection of an outstanding location should carry with it an increase in rental obligation, for again we must bear in mind that the sale of gasoline and oil and other products at a service station is no different from the sale of any other products. A good location is worth more in rental than a poor location.

This additional value, after careful consideration by management, should be added to the overall return which I have mentioned in the forepart of this article. The same factors in the middle class or poor location will have to be taken into consideration when establishing the rentals for outlets of this kind and where these adverse factors appear they should be given the same careful consideration by management, and corresponding rental reductions made. These casualties or sick stations frequently result from changed conditions, traffic flows, change in the character of the neighborhood over the period of ownership of the property by the oil company.

Penalty of Single Purpose Building

This brings us to the thought that a great deal of money has probably been wasted by oil companies in the building of service stations and making them a one-purpose building. The fallacy of this policy has been very definitely brought to the fore during this war period when so many service stations were forced to close. The oil company found itself with a building which could not be converted readily to any other purpose. The oil company simply continued to carry a dead property, or sold the land and the building for the price of the land, as the purchaser in most instances was compelled to destroy the building he could not convert to his own use.

As long as oil companies continue to build service stations, there will always be casualties in service stations locations. We should face this situation and erect buildings with removable interior partitions which can readily be taken out When the station does become a casualty it could be sold or leased as a small grocery store, drugstore, or used for

Tri-Sure News

NUMBER 30 ★ 30 ROCKEFELLER PLAZA, NEW YORK 20, NEW YORK ★ JUNE, 1945

Unloading Fuel on a South Pacific Beachhead

Official Signal Corps Photo

NOW—MORE THAN EVER

THE war in the Pacific confronts us with the greatest supply problem in history. And the problem applies acutely to the drums that must deliver "liquid ammunition" to where it is needed.

The further our front lines move forward, the more critical the need becomes for steel drums. For, the longer it takes a drum to make the "round trip", the more essential it is to keep more *drums than ever* in use.

And that means it is more important than ever before to empty drums *promptly*, handle drums *carefully*, and return drums *quickly*—to keep every drum in action and moving as fast as possible.

Reprints of the above message, for poster use, will be gladly furnished without charge

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA

Why try to rob your competitor of lessee operators when good potential station lessees might be found in other retail lines? One marketing manager with more than 40 years' experience suggests that some retailers will get more return for their investment and work in a service station than in their present business

some other similar purpose. There would then be an increased resale value in the building itself as well as the land.

Oil company stations are well identified with signs indicating the trade brand of the gasoline sold at the location. It appears a waste of money to build super-duper buildings which cost a lot of additional money and add nothing to the intrinsic value of the property.

In connection with the building of service stations there is possibly no objection (in fact there are several advantages) to the oil company installing the underground tankage, the pumps for the dispensing of gasoline, the furnishing of lifts and air compressors, and the containers for lubricating oils and greases, provided all these items are taken into consideration in the rental value of the property. Leasing the location to a dealer is a turn-key job. The furnishing of this equipment should not, however, include lubricating and greasing equipment as these should be provided by the dealer. They are the tools of his trade and should be furnished by him just as the carpenter furnishes his own saws and hammers.

Seek Lessees From Other Lines

After the selection of the proper location and the erection of a correct type of building then comes the most important thing in the entire transaction, the selection of the individual or concern to whom the property is to be leased. Very largely, in the past, the people in the field have apparently devoted most of their effort to find some man who has previously been in the service stations business. They will even attempt to raid a competitor who seems to have a successful operator in one of their stations by offering a "better" location at a reduced rental.

Very little effort has been put forth to seek out a man who has been successful in some other small business where the returns on his capital, time and effort have been only nominal. The same effort put forth in the service station business would bring him a very much larger net income.

Such individuals are available but they have largely remained away from service station operation, first because oil companies have never sought them out; and second, oil companies have allowed the impression to prevail that the operation of a service station is a highly specialized business. The only thing requiring special knowledge in the service station business is the lubrication of the motor vehicle and motor tuneup where the station justifies such installation.

Experts in both lines can be employed without difficulty and it is unnecessary for the operator of the business to have

BALLOT ON LESSEE STATIONS

Lessee rentals (postwar) should be based on:

1—Straight gallonage .....
2—Gallonage with minimum, no maximum .....
3—Gallonage, with minimum and maximum .....
4—Flat rental .....

Oil companies should provide service, display and sales facilities for

1—Tires .....
2—Batteries .....
3—Automotive Accessories .....
4—Appliances .....
5—Ignition, brake and wash service .....

The lessee's purchase of other than petroleum products for resale should be made through the gasoline supplier

Yes ..... No .....

SEND YOUR VOTE TO:

National Petroleum News
1213 West 3 Street,
Cleveland 13, Ohio.

Throw away that back breaking bucket!

Make Deliveries EASIER and FASTER! Why trudge wearily back and forth between truck and tank, lugging a back-breaking bucket, when *one* easy trip will do it—if you have a *Brownie Pump and Meter System!* It speeds up your deliveries 50% to 75% . . . eliminates needless drudgery and loss through errors . . . and *pays for itself in 6 months!*

TOSS OUT SHRINKAGE TROUBLES! This is another big advantage you get with an easily-installed Brownie Pump and Meter System. You fill orders right to the gallon; no more and no less. You just preset meter to gallonage desired, insert nozzle in your customer's tank-pipe, and turn it on.

That's all. An *automatic* valve cuts off flow when indicated number of gallons have been delivered. There is no muss or spilling, no need for extra help; it's a fast, easy, one-man job.

Your customer is assured of *full* measure and fast, efficient, confidence-winning service . . . and *you* are protected against unmetered, profit-losing over-filling. This feature alone means more customers for you.

SEND for this new bulletin! It has 8 colorful pages illustrating the popular new BROWNIE HOSE REELS and other features of Brownie Pump & Meter Systems for truck tanks. Tells how to make an efficient, profitable "pumper" out of your present bucket-type truck .. . and at remarkably low cost! **Write today!**

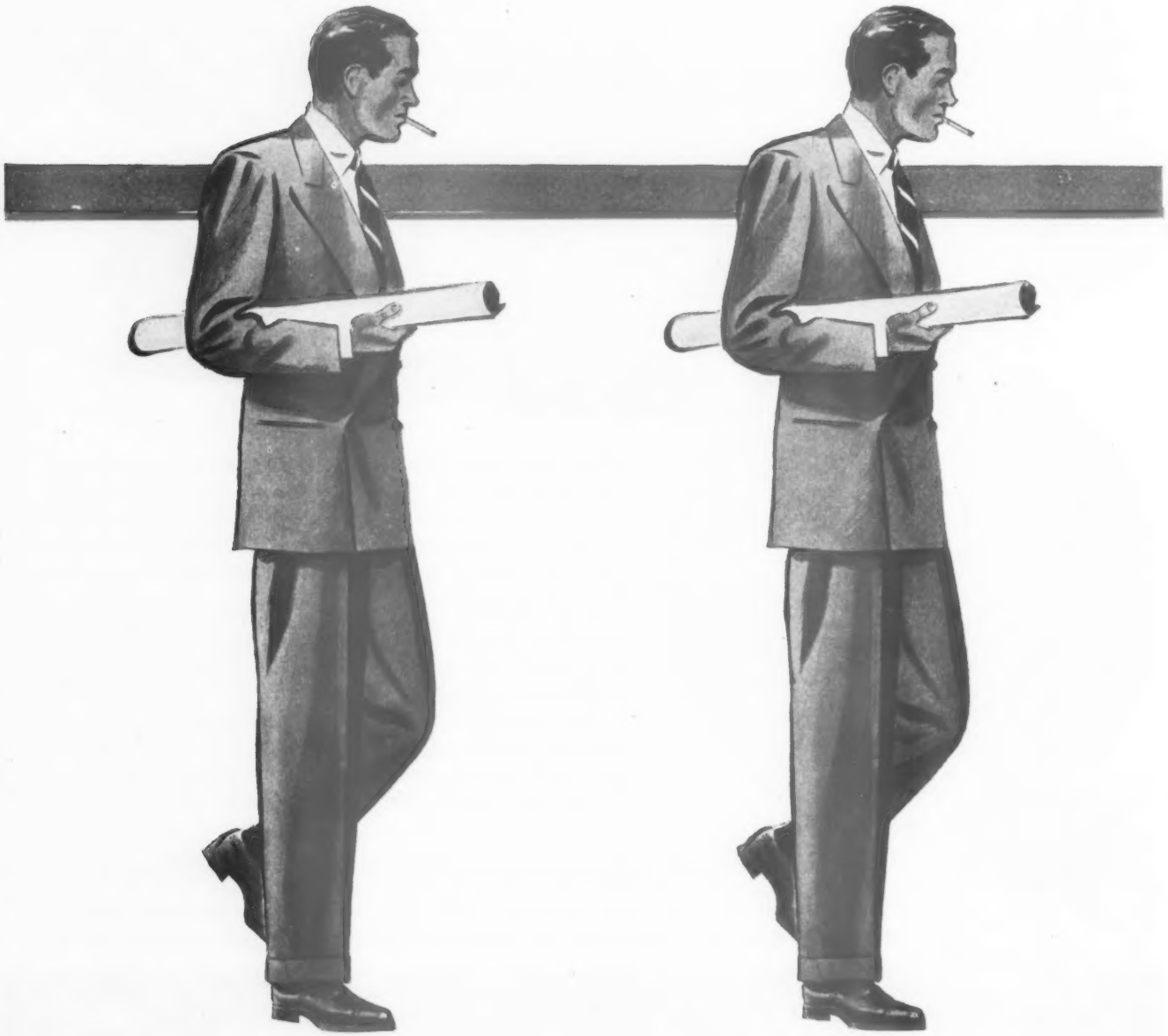
PROMPT DELIVERY *assured on orders for Brownie Systems for truck tanks.*

BROWN STEEL TANK COMPANY

2901 4th STREET S. E. MINNEAPOLIS 14, MINNESOTA

This is the third of a series of three advertisements discussing the economics of postwar remodernization.

THERE'S A DIFFERENCE HERE THAT'S WORTH INVESTIGATING!



225 Broadway, New York 7, N. Y. • Jersey City, N. J. • 609 South Grand Ave., Los Angeles, Calif • Philtower Bldg., Tulsa, Okla
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AT CASUAL FIRST GLANCE, the relative values of different refining engineering services are as deceptive as the difference between a custom-tailored suit and its ready-made carbon copy.

From the standpoint of maximum economic advantages and profit possibilities . . . refining managements know that only a *custom* job will put over their postwar remodernization plans. And that is still another reason why the "custom" touch that distinguishes a Kellogg job is so important today.

For instance in catalytic cracking, Kellogg process design evolved its own commercial application of the outstandingly superior *Fluid* process. And in turn, each application of *Fluid* Cat-Cracking by Kellogg is individually altered as required to best meet a client's special needs.

Similarly, Kellogg was first to apply the "Tower" method of propane deasphalting to commercial lube oil production . . . then went on to utilize the process to treat heavy charge-stocks for catalytic-cracking. These Kellogg Pilot-Plant proven innovations in refining pay direct dividends to clients. For example, in a 40,000 bbl. refinery, propane pre-treatment of asphalt bearing reduced crude can mean as much as three-quarters of a million dollars increase in annual operating income.

It is not merely a knowledge of process design that Kellogg relies on to make commercial plants meet production goals. What really counts is what is done with those processes . . . *how and why* they are applied to the individual job.

We think it fair to say that if you will consult the record of Kellogg's "custom" approach to its customers' problems . . . you'll consult Kellogg on your postwar remodernization plans.

THE M. W. KELLOGG COMPANY

Engineers and Economists to the Petroleum Refining Industry

Only Kellogg Service Has Them All

LABORATORIES – fully equipped and staffed – devoted exclusively to chemical engineering and process development.

24-HOUR-A-DAY PILOT PLANTS – 17 refining processes operating continuously – providing accurate data for commercial scale application.

EXCLUSIVE CHEMICAL ENGINEERING DATA – Continuously compiled . . . embracing both pilot plant runs and the operation of Kellogg-built refineries. Data extends from beginning of modern refining.

PROCESS ENGINEERS – Specialists who have continuously made major contributions to oil refining development, for more than 20 years . . . currently exemplified by their work on fluid catalytic-cracking.

MECHANICAL ENGINEERS – Kellogg installations – worth hundreds of millions – are their best reference.

METALLURGICAL LABORATORY – Establishes continuous check of specifications...creates new techniques for the fabrication of refining equipment.

PERMANENT CONSTRUCTION CREWS – Geared to function all over the world on single units or multiphase refineries . . . team-experience cuts costs, speeds construction.

OPERATING STAFFS – Specialists at placing new units "on stream" . . . training of refiner's own operating crews.

LICENSING SERVICE – Licenses available through Kellogg as Licensor or licensing agent for all types of refining processes.

ECONOMICS CONSULTATION – Offers oil companies the opportunity to have their overall operations reviewed and evaluated by personnel with authoritative and extended experience in the field of petroleum economics and management.

KELLOGG

Some integrated oil company managers think that there is too much money invested in "atmosphere" in service stations. Thinking in terms of postwar competition, prices and economics one manager with 40 years' experience says the industry should cut down on the frills if lessee stations are to pay out

detailed technical knowledge of either of these services.

Finding the right man to lease the station, we are then brought to the realization that most such prospects do not want to invest from $1000 at the small stations to $4000 or $5000 at the larger stations when they find there is a 10-day cancellation clause in the oil company lease contract. To induce a man to go into a location of this kind, invest his money in an adequate stock and the tools of his trade, and hold him under the fear of possible cancellation of his lease, is unjust to the tenant and unnecessary.

The laws in most of the states permit the property owner to restrict the use of his property to the sale of products supplied by the owner. Exceptions to this rule can be made by mutual agreement at the time of the signing of the lease. Under such circumstances there is no reason why the oil company should not lease its property to the operator or dealer for a period of one year or even longer.

These are some of the thoughts that occur to one who has spent a great many years in the marketing end of the oil business. Some of these suggestions may correct evils which have crept into the industry in this matter of service station rentals.

Revised Order PAO 12 Liberalizing Equipment Use Involves New Handling of Forms, Oil Men Find

NPN News Bureau

CHICAGO—The number of inquiries from jobbers and oil company representatives received at PAW Dist. 2 headquarters since amendment of PAO 12 on May 3 indicates that the revised order is not too well understood by the industry.

As the order now stands, it permits (1) the **use** of material and the **installation** of equipment at bulk plant locations when the combined cost of material and equipment does not exceed $5000 for one complete operation; and (2) the **use** of material and the **installation** of equipment at retail outlets or consumer accounts when the combined cost of material and equipment does not exceed $1000 for one complete operation.

However, the amended regulation does several other things, according to the best information available in the absence of an official interpretation. It eliminates the use of PAW Form 23 and specifies that PAW Form 30 should be used in making request for exceptions.

It should also be borne in mind that PAO 12 governs only the use of material in marketing operations, and does not give priorities assistance or preference ratings for acquiring that material. Preference Rating Order P-98-b covers priorities for obtaining some material, but not "equipment" as defined in PAO 12. It does not authorize preference ratings for material to be used at retail outlets, except for actual "maintenance and repair" and "operating supplies," with the further exception that the rating and symbol AA-3; MRO-P-3 may be applied to secure up to $100 worth of material to make each complete installation of "equipment" such as pumps and tanks, at a retail outlet or consumer account.

Except for the acquisition of storage tanks having a capacity exceeding 65 gallons and service station-type pumps, material having a total cost of up to $500 may be obtained with the priorities assistance of P-98-b for any use authorized by PAO 12 at **bulk plants**, using the rating and symbol AA-1; MRO-P-3. This is in addition to material acquired under the same rating and symbol for actual "maintenance and repair" and "operating supplies".

Other Forms May Be Needed

If an operator **cannot** complete an operation under the cost limitations of paragraph (c) (3) of PAO 12 he must file an application on PAW Form-30, as provided in paragraph (d) of the order, for an exception and for such priorities, if any, as will be required for **all** of the material and equipment which will be needed for the project.

If an operator **can** complete an operation under the cost limitations of paragraph (c) (3), but must apply preference ratings to secure "equipment" (as defined in PAO 12) or machinery, he may file an application for the necessary priorities assistance on Form WPB-541 with his nearest War Production Board office.

If an operator **can** complete an operation under the cost limitations of paragraph (c) (3), but is unable to acquire all of the necessary **material** under the MRO authorizations of P-98-b, he must file an application for priorities assistance on PAW Form-30, in accordance with the provisions of paragraph (d) of PAO 12. In this event, if priorities assistance should be required to also acquire "equipment" (tanks or dispensing pumps) or machinery for the project, the items of equipment and/or machinery should be included in the Form-30 application instead of applying separately for preference ratings for them on Form WPB-541.

A request for PAW Form-30 or WPB Form-541 may be addressed to: Director of Distribution and Marketing, Petroleum Administration for War, 624 South Michigan Avenue, Chicago 5, Ill. WPB Forms-541 are also available at all District and Regional offices of the War Production Board.

Wright Predicts Prosperous Era

Special to NPN

AUGUSTA, Me.—Willard Wright, New England regional manager for the Sun Oil Co., and former OPA official, speaking informally told a group of independent distributors at a meeting of the Maine Independent Oil Marketers Assn. at Lewiston on May 22, that an era of unprecedented prosperity awaits jobbers.

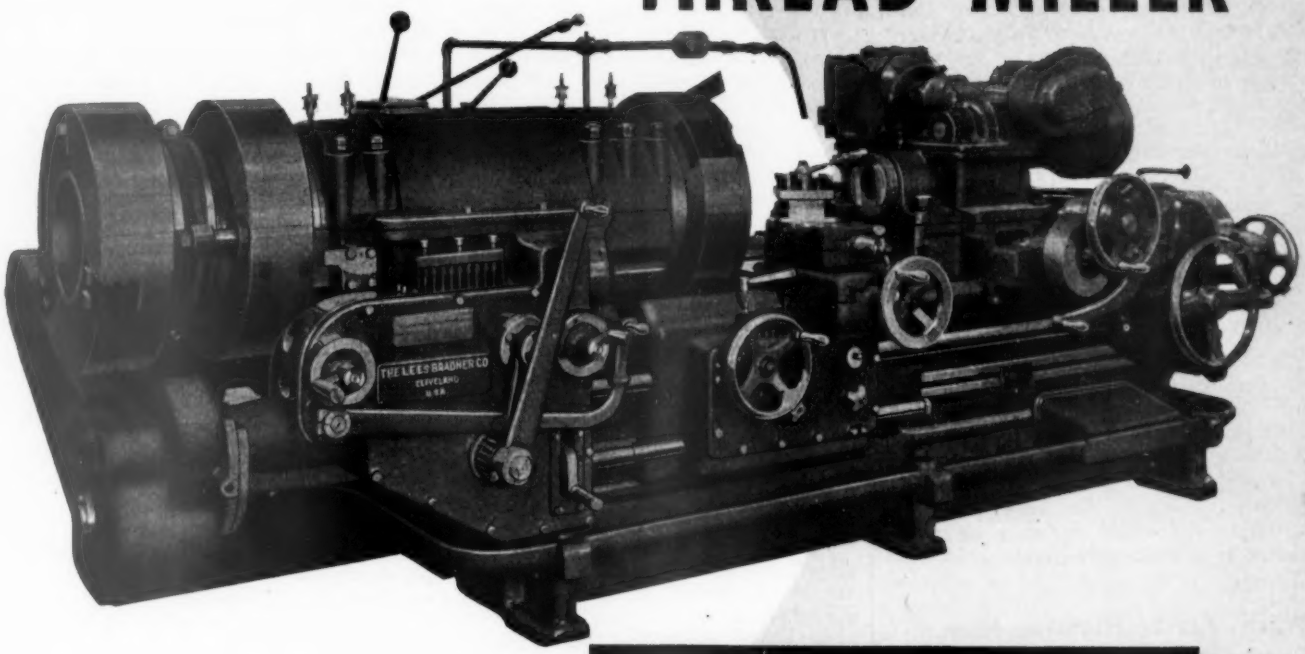
Mr. Wright said that the war has helped to define the respective spheres of operations for major companies and jobbers. "We know now the operations which can best be handled by independent distributors and major companies", Mr. Wright told this independent group.

If You are Threading Tool Bits, Tool Joints, Pipe or Casing, may we call Your attention to—

LEES-BRADNER

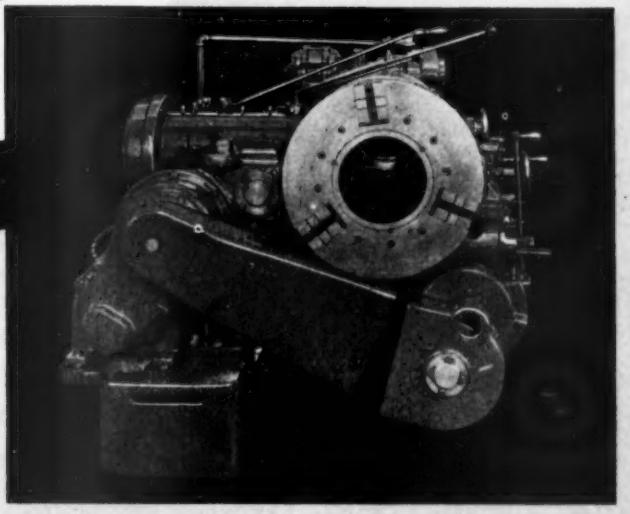
SUPER-DUTY "OW"

THREAD MILLER



CAPACITY

Steel—2 threads per inch with 8½ inch face



THE LEES-BRADNER COMPANY

CLEVELAND 11, OHIO

Sinclair Buys Pipeline Rights To Columbus and Detroit

NPN News Bureau

NEW YORK—Sinclair Refining Co., already mapping an ambitious system of postwar pipelines, has purchased rights of way from Toledo to Columbus and Steubenville, O., and from Toledo to Detroit, and has taken options on rights of way from Columbus to St. Louis, it was revealed here last week. Sinclair has also bought a site for a pipeline terminal in the immediate vicinity of Columbus.

Construction will be begun "when and if" materials and labor are available, and when official authorization has been obtained.

Both lines will probably be six-inch, and would be designed for transportation of gasoline and other refined products.

A year ago Sinclair completed an 8-in. pipeline from Chicago to Toledo at a cost of more than $5,000,000, and in 1942 a line from Marcus Hook, Pa., to Baltimore and Steubenville. It was originally intended to pump products west on this line, but it has been used for easternward transport east since its completion as a wartime measure.

Warns Alaska Highway Now Road for 'Adventurers'

NPN News Bureau

CHICAGO—The Chicago Motor Club, after receipt of inquiries from many motorists on postwar automobile trips along the Alaska Highway, has warned motorists not to attempt the trip.

"Because of the lack of gasoline and repair stations and the fact that places to eat and sleep are not to be found," the touring bureau of the club says, the trip should be made only by an adventurer able to take care of himself in the wilderness.

The United States Bureau of Roads says that, possibly in a year or two after victory over the Japanese, the road will be open to tourists, the motor club spokesman said.

"Twenty hours of daylight with twilight at midnight in midsummer, combined with a panorama of mountain lakes, sparkling streams and spruce forests, will make the trip a delight," he continued, but again warned motorists to wait until the highway is open to tourists.

U. S. and British Technicians in Conference With Army Combat Experts on Jet Engines

Special to NPN

SWAMPSCOTT, Mass.—A detailed study of jet propulsion and gas turbine developments was made here this week during final sessions of a national three-day conference sponsored by the Air Technical Service Command of the Army Air Forces and the General Electric Co.

Two hundred well-known practical and research engineers of major American aircraft and engine companies attended the meeting, together with a delegation from England. This was the first conference of its scope on jet propulsion ever held.

It followed a plan of the Air Technical Service Command to stimulate new advances in jet propulsion and gas turbines by pooling facts and ideas on harnessing this dynamic motive force for airplane power plants.

Air-power authorities during the conference centered attention on record-breaking accomplishments already achieved in jet propulsion under wartime pressure. General Electric engineers who designed and developed the Super G-E Jet, described as the world's most powerful aircraft engine, explained and demonstrated many jet propulsion developments.

These included classified performance data on G-E Jets, discussion of gas turbines for potential propeller drive on aircraft, combustion developments, metallurgical advancement and air compressor designs. The sequence of tests these new-type engines must undergo from factory to flights was reviewed.

Combat Officers Heard

Combat officers and other engineers contributed a discussion of the elements dealing with jet propulsion and gas turbine developments and uses, of which details cannot be made public at this time for reasons of military security.

Leading engineers of several companies, including Bell, Douglas, Lockheed, Republic, Ryan and Vultee, described fundamental progress which has been made by aircraft companies in designing and developing planes to be driven by jet engines or gas turbines.

Most of those who attended the conference agreed that the jet engine is already the ideal power unit for fighter planes, where speed is the major factor, while the gas turbine harnessed to a propeller with auxiliary jet would develop into the power plant for transport and cargo aircraft, including those designed for transoceanic and transcontinental operations.

A picture of air power tomorrow was painted by R. G. Standerwick, General Electric engineer who directed the designing and development of the G-E Jet. Mr. Standerwick said that knowledge gained by engineers under wartime demands would give tremendous impetus to aircraft transportation.

Tomorrow's Air Power Pictured

"I have in mind low-priced private planes of reasonably high economy, powered by gas turbine-driven propellers, and helicopters with jet propulsion gases being emitted from the trailing tips of the propeller blades," he said. "These will be for both private and delivery purposes. Large commercial freight lines and passenger lines will be employing planes powered by gas turbine propeller power plants."

American and British engineers earlier in the conference visited the test and development sections of General Electric River Works at Lynn, Mass., where the Super G-E Jet was developed, and where the first jet engine in the United States was produced from a British design. This plant is producing engines for both the Army Air Forces and the Navy.

Members of the official British delegation attending the conference included Air Vice Marshal L. M. Iles, controller of technical services of the British Air Commission; Group Captain G. Watt, deputy director of turbine engines of the Ministry of Aircraft Production; W. G. Barter, chief designer of the Gloster Aircraft Co., and Maj. F. B. Halford, technical director of the DeHavilland Engine Co.

Devise New Driving Aids To Help Wounded Vets

NPN News Bureau

NEW YORK—Driving aids which will enable wounded veterans of this war again to drive automobiles are now being devised by the War Engineering Board of the Society of Automotive Engineers, at the request of the American Assn. of State Motor Vehicle Administrators and the Surgeon General, it was recently announced.

As soon as the government gives manufacturers final authority to begin manufacturing on a commercial basis, the apparatus data worked up by engineers of the Society, will be made available to vehicle manufacturers so that each company may make adjustments or improvements to suit the individual characteristics of the particular make or model car.

These devices will permit even men who have lost limbs to drive a passenger car or light truck, and will be so simple that local garages will be able to install them. However before a driving license is issued, the veteran will be required to take state examinations and driving tests, but arrangements will be made by state motor vehicle administrators to save the veteran time and inconvenience. Detailed work of the project has been carried through by the board's Committee on Vehicle Controls for Disabled Veterans.

LIFE LINES
to Dealers

Automobiles, telephones, radios, vacuum cleaners, washing machines, refrigerators, ranges—ownership of these items is an outward symbol of the American standard of living.

Indication of the *quality* of LIFE's vast audience is the fact that 7,700,000 LIFE readers live in households that have *all seven* of these items. What a replacement market for automotive products!

• • •

So when car, and car accessory manufacturers, and manufacturers of petroleum products advertise in LIFE, they're really talking to the *right people!*

The U. S. faces a disastrous motor vehicle shortage either before the war ends, or immediately thereafter, warn government and highway association officials.

Bending their backs to help keep cars on the road are automobile dealers and service station operators, like William Steinmetz, of White Plains, N. Y. (shown above).

Mr. Steinmetz, an Esso dealer, never misses an opportunity to check tires, remind motorists to have their cars lubricated regularly, and to caution that low mileage doesn't mean that they can do without frequent changes of oil.

• • •

Car protection is a timely story for manufacturers of petroleum products right now.

And LIFE has been entrusted with a large share of the important job of telling motorists how to save their cars.

For instance, in 1944 LIFE carried 30 per cent of the total advertising investment in magazines for gasoline and oil.

• • •

The local impact of LIFE is illustrated by what happened at the Cleveland Museum when LIFE carried an article on the art treasures there.

There was an immediate increase of 68 per cent in the Museum's attendance over corresponding periods of the previous year!

• • •

LIFE moves people to act!

When Allied Armies pushed across the Rhine to wind up the *Wehrmacht*, six top-flight LIFE photo-reporters went with them. First to drop in on the party was Robert Capa, who parachuted with airborne troops ahead of Montgomery's bridgehead. Just before boarding his plane in France, Capa made this striking picture of an American paratrooper about to take off. This LIFE picture is a fine example of the kind of close-up photo-and-text reporting that 22,000,000 eagerly read in LIFE week after week.

LIFE has more readers every week than any other magazine . . .

LIFE sells your customers . . .

They learn what's new in LIFE

DIRECT DELIVERY TO RETAIL STATIONS ... by Tank-Trailer

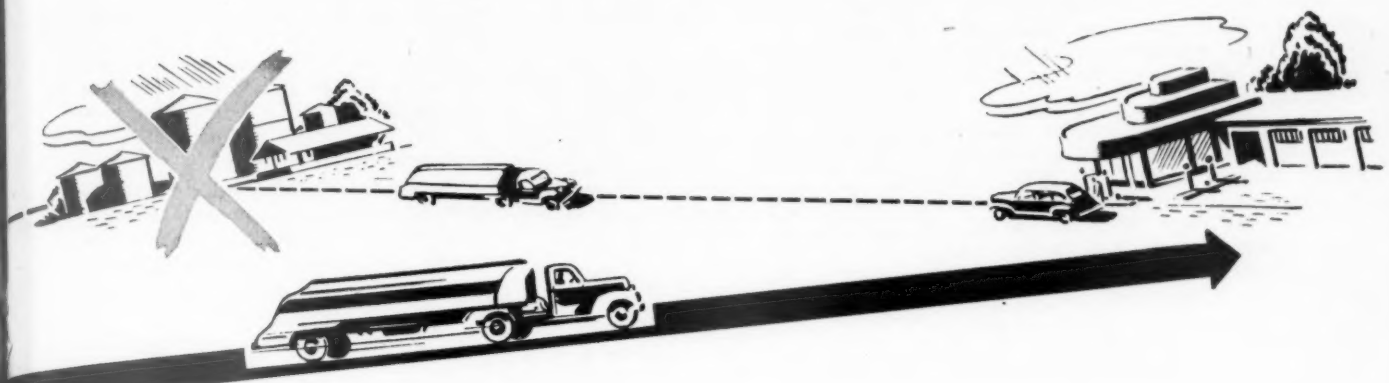
*Comparative Summary of Operating Figures for 1938 and 1944

	1938	1944
Number of motor vehicles	58	25
Number of tank-trailers	0	14
Number of bulk stations	33	21
Average capacity per vehicle (gallons)	1081	3120
Average delivery per stop per station	335	2008

This advertisement is repeated from an earlier issue which showed 1943 figures compared with 1938. Average delivery per stop per station shows continued increase from 1855 gallons in 1943 to 2008 in 1944.

MORE FRUEHAUF TANK-TRAILERS ON THE O

How One Major Oil Company Eliminated 12 Bulk Stations . . . Uses Half as Many Trucks . . . and Increased Average "Dump" Per Station 500%



IN 1938 the Detroit division of one of the major oil companies had 58 tank-trucks . . . but no Tank-Trailers. Gasoline was shipped by rail from pipe-line and marine terminals to bulk depots and then distributed by truck to local service stations.

Today this division operates with only 25 motor vehicles . . . plus 14 Tank-Trailers. Shipment by rail has been entirely eliminated, releasing the tank cars for the long eastern haul.

The big Tank-Trailers . . . five 2-trailer "trains" with 8,000 gallons capacity and four 3,600-gallon Semi-Trailers . . . deliver gasoline directly from terminals at Toledo, Detroit, Bay City, St. Joseph and Grand Haven to retail stations in the surrounding areas.

The economy and efficiency of the Tank-Trailer method are strikingly shown by a comparison of 1944 operating figures with those of 1938*. With less than half as many power units, the total gallonage handled was much larger . . . yet there was a sizable reduction in vehicle mileage—a big saving in rubber and gasoline—and a similar saving in steel. An announcement by the War Production Board said, "Tank-Trailers . . . transport more oil per pound of steel and rubber and require less manpower than any other type of vehicle available for general use."

Not only are Tank-Trailers most efficient per pound of critical materials . . . they are the most flexible means of oil transportation—able to move into any territory, on schedules to meet emergency conditions as well as regular deliveries.

A Tank-Trailer is ready to leave the minute it is loaded. There's no waiting for a locomotive, or for other cars to be loaded, or for a time schedule. On many hauls, one Tank-Trailer delivers several times the gallonage that one tank car can deliver . . . because, of course, the Trailer works continuously and makes more round trips. Actual records show that one Tank-Trailer is often the equivalent of 11 tank cars!

Tank-Trailers for essential civilian use are now being built under the civilian production program. But production is limited, so if you are planning the purchase of a new Tank-Trailer, you should file application form WPB-663 immediately. Your local Fruehauf Branch will gladly assist you.

World's Largest Builders of Truck-Trailers **FRUEHAUF TRAILER COMPANY • DETROIT 32** Service in Principal Cities

Fruehauf TRAILERS

"ENGINEERED TRANSPORTATION"– Reg. U. S. Pat. Off.

THE ROAD THAN ANY OTHER MAKE . . . .

Mexico Gas Export Ban Is Doubly Resented

Special to NPN

McALLEN, Texas—An attempt will be made to get the Federal Power Commission to change its ruling against exporting Texas natural gas to industries in Mexico, officials of the La Gloria Corp. have revealed.

In its original application, turned down by FPC on May 8, La Gloria sought to pipe natural gas from the Weslaco gas-distillate field of southeastern Hidalgo County, Texas, to Gas Industrial, S. A., of Monterrey, Mexico. La Gloria planned to build a line from the field to the international boundary at Reynosa, where the Mexican corporation would pick it up and pipe it to the large industrial city of Monterrey in northern Mexico.

L. A. Clark, who represents La Gloria here, said FPC disapproval of the application came as a "surprise". The move had been opposed by the Texas Railroad Commission on the grounds that the end use of the gas in Mexico would not contribute to the war effort, and that the hopes of Texas of becoming an industrial state would vanish if its prime attraction, cheap fuel, was exported from the state.

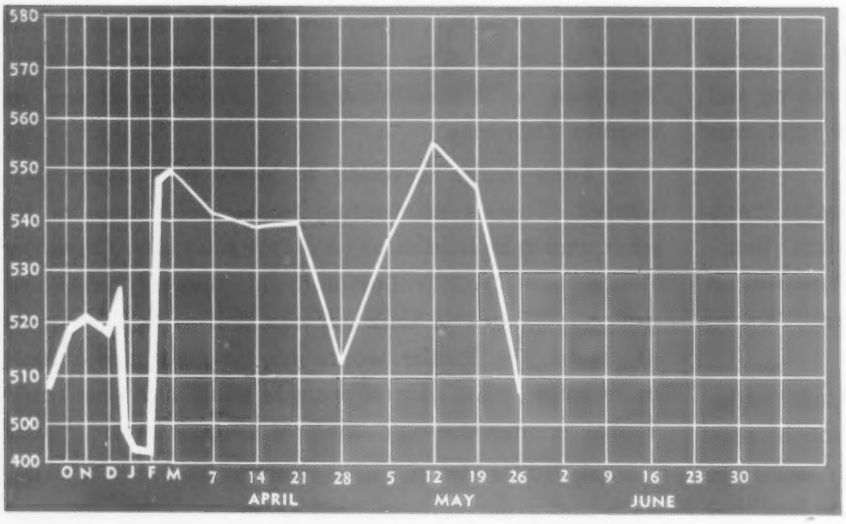
The Monterrey industrialists, miffed at the FPC action, charged that it constituted a reversal of the good neighbor policy and vowed to see that potential Mexican gas wells were developed. It had been reported that one prospect metered 3,000,000 cubic feet daily, which is not very large as gas wells go.

Canada Eases Parts Rules

Special to NPN

OTTAWA — All government restrictions on the manufacture, distribution and use of motor vehicle replacement parts and accessories have been removed.

Rail Hauls to East Decline 37,304 b/d



NPN News Bureau

WASHINGTON—Tank car shipments of crude and products to east coast dropped 37,304 b/d during week ended May 26, totaling 505,783 b/d compared with 543,087 b/d previous week, PAW reported this week. Total of 16,443 cars were loaded by companies compared with 17,658 week before, as follows:

Allied Oil Co. Inc.	46	Gulf	1496	Root	112
Allied Oil Co. of Ill.	21	Hartol	240	Royal Petroleum	89
Amsco	154	Hunt	19	Shell	1167
Arkansas Fuel	87	Industrial	7	Sinclair	311
Ashland Refining	246	Jenney Mnfg. Co.	87	Skelly	11
Asiatic Petroleum	43	Libby	2	Socony-Vacuum	1766
Atlantic Refining	345	Maritime Oil	37	Southland	15
Bell Oil & Gas	4	Mid-Continent	21	Southport	6
James B. Berry Sons	12	National Refining	1	S. O. California	4
Cantelou	17	Ohio Oil	41	S. O. Indiana	431
Carbide & Carbon	85	Pan American	1266	S. O. Kentucky	84
Chalmette	21	Pana	11	S. O. New Jersey	2900
Champlin	86	Petroleum Heat & Power	9	S. O. Ohio	186
Cities Service (Pa.)	401	Phillips	199	Sun	2026
Continental	20	Premier	30	Talco	33
Cosden	60	Primrose	14	Texaco	1472
Crown	34	Pure	158	Tide Water	60
Daugherty	18	Republic	231	Tiona	5
Dornoil	8	Richfield	90	Triangle	9
Drake	21	Rock Island	4	United	16

June Quotas Cut Total U.S. New Car Pool to 2500

WASHINGTON—The nation's supply of new 1942 automobiles will total less than 2500 after another 1500 of the vehicles are made available to eligible buyers in June, OPA estimated this week. The June quota is the same as that announced for May. Two factors lead OPA to believe, however, that remaining supply can be "stretched" until factories begin producing cars again.

The present eligibility list is limited to eight highly essential groups, and many persons receiving certificates for purchase of new cars get used ones instead, so the supply of new vehicles does not diminish as rapidly as quotas permit.

When car production resumes, OPA said it plans to base eligibility on the number that manufacturers will be able to turn out in each quarter and eligibility lists will keep pace with rising output.

Regional quotas of new 1942 cars for June, identical with May allocations, are as follows:

Region	Quota	Regional Reserve
I (Boston)	119	12
II (New York)	327	33
III (Cleveland)	182	18
IV (Atlanta)	173	17
V (Dallas)	254	25
VI (Chicago)	203	20
VII (Denver)	44	5
VIII (San Francisco)	198	20
Totals	1,500	150

OPA Charges Pershing Oil Co. With Illegal Service Fees

NPN News Bureau

CHICAGO — Metropolitan OPA here has been issued a restraining order by Federal District Court to prohibit the Pershing Oil Company from further overcharges in its automobile servicing department and to force it to maintain proper records, according to an OPA announcement.

OPA said charges were from 25 to 50 cents above ceiling for the changing of tires and that other prices had been illegally increased.

OPA also has filed charges in Federal Court charging the Abbey Garage here, with collecting above the maximum prices, for storage of automobiles. Unestimated treble damages are asked.

Delay California Road Program

Special to NPN

SACRAMENTO, Calif.—The California State Legislature last week temporarily shelved plans to build elaborate freeways and limited access highways in California.

The proposed bill would add another 1½c tax on gasoline to finance construction. The plan has not been abandoned, however, as the assembly already has passed a bill supporting construction of the new highways.

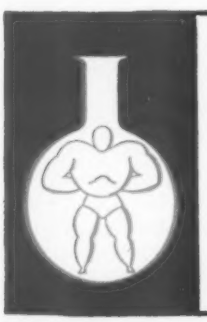
PARAPOID

PARATONE

● Bringing the tested results of continuing research to the nation's refiners and compounders

PARATAC

PARANOX



Among the Giant molecule products for better oils developed by us and the Standard Oil Development Company are:

PARATONE—Viscosity Index Improver
PARAFLOW—Pour Depressant
PARATAC—Tackiness Additive
PARAPOID—Extreme Pressure Additive
PARANOX—Inhibitors—Detergents

To make good lubricants better!

Utilizing a background acquired by years of experience in the oil industry, coupled with tireless research in the largest lubrication research and engine laboratories, we are prepared to meet the needs of refiners and compounders—large and small—who want to improve their products for military or civilian uses with up-to-the-minute additives.

Send inquiries and orders to PARAFLOW SALES DIVISION, Chemical Products Department, Stanco Distributors, Inc., 26 Broadway, New York 4, N. Y.

Gulf Strikers Return To Their Jobs at Port Arthur Plant

Special to NPN

PORT ARTHUR, Tex.—A costly five-day strike of some 5000 employes in one of the world's largest refineries handling aviation gasoline has ended after application of considerable pressure from the Army, War Labor Board, and PAW.

It marked the first time the big Gulf Oil Co. refinery had been closed since the hurricane of 1915.

The walkout by the CIO-affiliated International Oil Workers Union started when, according to the union version, a foreman refused to take a crew into what he termed a dangerous area to repair a leak and was suspended by the company.

About 3500 Oil Workers unionists walked off the job following the suspension and 1500 A. F. of L. affiliated workmen stopped in sympathy.

The men stayed out until May 31 when they returned to their jobs on the 8 a.m. shift following an ultimatum from the regional WLB at Dallas given them the afternoon before. The army's Eighth Service Command, which intervened some weeks ago in a similar strike at Lake Charles, also indicated it would take action should any violence develop. There was no report of violence in connection with the strike.

Homer Coffman, secretary of the local union, charged that the man was suspended without reason and that efforts of the union's stewards to gain audience with the company were of no avail.

R. C. Faulkner, Gulf superintendent, issued a statement in which he said the company would not deal with the union representatives until they returned to the job, in accordance with their contract.

The men returned to work after a union meeting. The C.I.O. and O.W.I.U. termed the walkout unauthorized and aided in getting the men back.

Fish on German Council

Mr. Fish

NPN News Bureau

WASHINGTON—From Supreme Headquarters in Paris came a recent announcement that Lounsbury S. Fish, organization counsel for California Standard, and formerly with PAW and WPB, has been added to the United States Group Control Council for Germany.

Mr. Fish has been granted a long leave of absence from his company, and his chief task will be to aid Lieut. General Lucius Clay, Deputy military governor in Germany, to set up the council organization.

Goodrich Producing New Type Synthetic Rubber

Special to NPN

LOUISVILLE, KY.—A 15,000-ton a year production of a new type of synthetic rubber for tires has been announced by a Louisville plant of the B. F. Goodrich Co.

The product uses for emulsion a soap solution with a base of rosin acid, derived from the abundant southern pine.

The Louisville plant manufactured 10,000 tons of this special variant of GR-S rubber in less than a year, and is now on a 15,000-ton a year production basis.

Named GR-S-10 and sometimes called rosin soap rubber, this special product has properties which reduce tread cracking and increase road wear, W. S. Richardson, president of B. F. Goodrich Chemical Co. said.

Rice Invention Will Increase Diesel Operating Power

Special to NPN

RALEIGH, N. C. — North Carolina State News Bureau recently reported a new device enabling use of heavy and crude oils for high-speed Diesel engines. It is the invention of Prof. Robert B. Rice, Director of Diesel Engineering at State College.

A new type of mixing chamber is involved in the device from which it will be possible to derive more power and speed from an engine of a given size, Bureau said.

PAW Issues Safety Guide

NPN News Bureau

WASHINGTON—Announcement has been made by PAW of a 175-page wartime safety guide for refinery management and supervisory personnel, entitled "Wartime Recommendations For Refinery Inspections." It was prepared by PAW's facility security division at the request of the PIWC Committee on protection of Petroleum Facilities. The document contains 57 pages of charts, diagrams and illustrations, and is based on the "tentative API Code of Good Practice for Refinery Inspection Procedure."

Jersey Standard Avgas Unit in Baton Rouge Makes Billionth Gal.

Special to NPN

BATON ROUGE, La.—Employees of the Standard Oil Co. of New Jersey refinery here paused briefly in their work on the afternoon of June 1 to mark a war production milestone; the production of the billionth gallon of 100-octane aviation gasoline.

The Baton Rouge refinery is the second in the country to reach the billion-gallon mark in high-octane gasoline. The first was another Jersey Standard affiliate, the Humble Oil and Refining Co., of Houston, Texas, which achieved the goal in December. The refinery here has also manufactured components of high-octane for blending purposes at other refineries, which, added to the finished product, sends its production well over 1,500,000,000 gallons.

At the ceremony last Friday, the billionth gallon was accepted by Major James F. Collins, a native of Baton Rouge, who distinguished himself in Pacific aerial fighting. He is the holder of the Distinguished Service Cross and the Distinguished Flying Cross.

High Officials Guests

Among special guests were Gov. James H. Davis of Louisiana, and Maj. Gen. Troy H. Middleton, commander of the Eighth Army Corps, now on leave at his home in Baton Rouge.

Among congratulatory telegrams which arrived at the refinery from members of military and state officialdom in Washington were those from Gen. H. H. Arnold, Commanding General of the Army Air Forces; Harold L. Ickes, Secretary of the Interior; Gen. H. L. Goerge, Commanding General of the Air Transport Command; J. A. Krug, Chairman of the War Production Board; Robert P. Patternson, Undersecretary of War; Artemus L. Gates, Assistant Secretary of the Navy for Air; Sen. Joseph C. O'Mahoney, Chairman of the Special State Committee for investigating petroleum resources; Sen. John H. Overton and Sen. Allen Ellender, Louisiana, and Congressman James Morrison, of Louisiana.

Sinclair Wyoming Refinery Fills Millionth Barrel

Special to NPN

SINCLAIR, Wyo.—M. H. Nolan, refinery superintendent of the Sinclair Refining Co., on Memorial Day, announced that the company had produced its 1,000,000th barrel of 100-octane aviation gasoline.

Both Petroleum Administrator Harold L. Ickes and Deputy Petroleum Administrator Ralph K. Davies telegraphed their congratulations to the Sinclair employees, and highly praised their work in "this impressive contribution to the war program."

HERE'S TROUBLE-FREE PACKAGING FOR OIL... CANS, OF COURSE!

Cans eliminate tampering... assure clean oil... provide convenience, sales appeal!

● "As a marketer, I'm vitally concerned with *trouble-free packaging* for oil. So are service station men and motorists. And experience has proved that *cans* are *really* trouble-free!

"You see...cans eliminate the danger of tampering ... the substitution of inferior grades. They're the motorist's assurance of getting what he wants—full measure... clean, dependable oil. What a boost to public confidence and brand preference!

"To service station men, cans mean neatness... convenience... safety from breakage and fire. And cans are easy to display...have lots of sales appeal.

"Every point a packaging plus! So take my tip... pack your oil in steel-and-tin *cans*—when cans become widely available once more."

WATCH FOR NATIONAL ADS!

More than 31,000,000 printed messages—full-page ads in full color—are appearing this month in 6 big consumer magazines and in Sunday supplements on a nation-wide scale. This powerful ad campaign reminds readers how *cans* help *them*...points out that no other container combines so many advantages.

HERE ARE THE

5 MAJOR REASONS

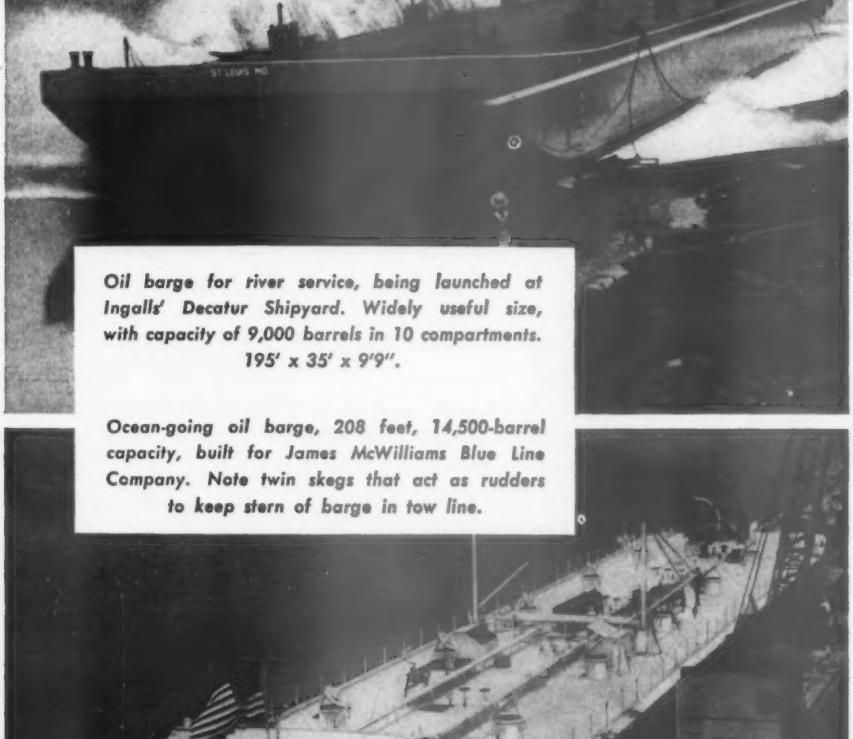
Why Motorists Prefer
OIL IN CANS!

1. Safe from tampering and substitution.
2. Cans protect quality.
3. Cans assure full measure.
4. Cans are more convenient.
5. Cans are cleaner.

CAN MANUFACTURERS' INSTITUTE, INC., NEW YORK

NO OTHER CONTAINER PROTECTS LIKE THE CAN

Oil barge for river service, being launched at Ingalls' Decatur Shipyard. Widely useful size, with capacity of 9,000 barrels in 10 compartments. 195' x 35' x 9'9".



Ocean-going oil barge, 208 feet, 14,500-barrel capacity, built for James McWilliams Blue Line Company. Note twin skegs that act as rudders to keep stern of barge in tow line.

Will Cut Costs, Add Ease and Speed to Operations

Using a basically efficient type of construction — 100% welded — pioneered by this builder for warships and cargo ships, Ingalls has also developed a number of patented features that give new strength, efficiency and maneuverability to barges. *Twin Skegs* eliminate yawing. *Sloping Collision Bulkhead* braces ends of barge against strain. *Many Watertight Compartments* provide buoyancy. *100%-Welding* adds strength without extra weight, reduces cost of construction, shipping, operating. Consult with Ingalls to get the benefit of our experience in designing, building and erecting gasoline and oil storage tanks, as well as oil barges.

THE INGALLS SHIPBUILDING CORP.
Two Shipyards: Fascagoula, Mississippi and Decatur, Alabama.
Offices: BIRMINGHAM, Pittsburgh, New York, Washington, New Orleans.

INGALLS *Ships*

General Petroleum To Expand Refinery

NPN News Bureau

LOS ANGELES—The General Petroleum Corp. has started a $3,000,000 building expansion program at its Torrance refinery, officials disclosed last week.

The new structure will provide General Petroleum with an additional refining process, identified as "delayed recycle coking," which puts a phenomenal pressure and temperature squeeze on raw materials being processed and is designed to get "the last squeal out of the pig" before reduction of crude oil to the coke stage.

The additional facilities will have a capacity of from 13,000 to 15,000 bbls. of components daily and will make the Torrance plant one of the most efficient in the industry, spokesmen said.

Fundamentally, it was revealed, the new unit is General Petroleum's answer to the predicted decline in crude production in the post-war era. Through the "delayed recycle coking" method, the heavy, tarry crude residues left over under current refining methods, which hitherto have not been refinable, may now be given "the squeeze" until nothing is left but coke.

What happens in the "delayed coking" process is that heavy tarry crude oil residues are converted to light desirable hydrocarbons, gasoline and gas oil distillates without any of the heavy liquid product remaining. Some 330 tons of solid coke comprise the end product daily. Furthermore, a statement said, the light hydrocarbons will be reprocessed by alkylation to produce more 100-octane gasoline to power the Superforts which are reducing Japan to rubble.

Texaco Announces Educational Leave Plan For Veterans

NPN News Bureau

NEW YORK — Announcement has been made by The Texas Co. of an educational leave plan to employes who return from military service and desire to take advantage of the Servicemen's Readjustment Act of 1944 (the G. I. bill).

W. S. S. Rodgers, chairman of the board of directors, in making the announcement, said that in addition, financial assistance in the form of loans without interest will be extended to these veterans in cases where the amount available under the law may be inadequate.

The leave is for one year, subject to extension at the end of each year, provided the employe is making satisfactory progress in his studies. The leave is available to any employe who had at least four months' service with Texaco before entering military service.

More than 5000 men and women of The Texas Co. are on military leave of absence.

California Standard Denies NLRB "Domination" Finding

Special to NPN

SAN FRANCISCO — Finding of the National Labor Relations Board that the Standard Oil Employes Assn. is company dominated and must be disestablished, will be contested, California Standard announced.

This decision was disclosed in a statement by Standard which entered a blanket denial to charges that company both dominated the association and interfered with employes free choice of a collective bargaining agent. Statement added:

"The Employees Assn. has been a bargaining agent for company employes for the past 11 years. The United States Department of Labor in 1934 examined the relationship between the company and the Employees Assn. at the request of the Oil Workers Union. The Labor Department's investigator, E. Marsh, at that time reported that the union was the free choice of the employees and that they were not dominated. He found further that 'the company was scrupulously careful to obey the letter of Sec. 7A' of the National Industrial Recovery Act.

"Later, on four separate occasions, the National Labor Relations Board conducted its own investigations at the instigation of the Oil Workers Union, and each time dismissed the cases.

"It is important to note that all these earlier investigations were made at the time the alleged acts were supposed to have occurred, rather than ten years later, as in the present case.

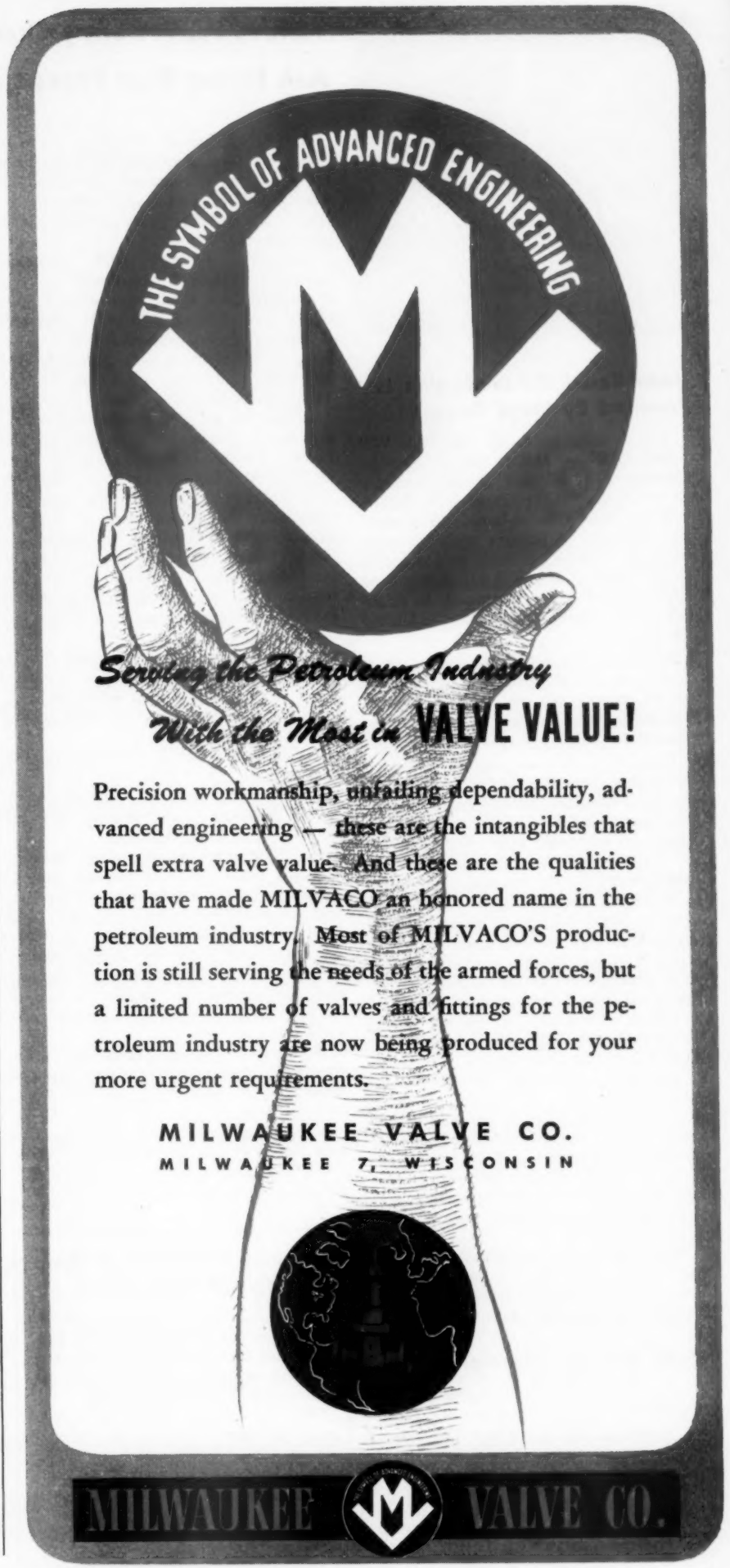
"Our company's various contracts with different unions are further evidence that our employees have freely exercised their choice of collective bargaining agents. Particularly is this shown by the fact that our employees again chose the Standard Employees Assn. as their bargaining agent in the election supervised in Richmond last year by the National Labor Relations Board itself.

"We believe that Congress intended through the National Labor Relations Act to give the employees the ri ht to choose freely as to what union or unions they want. Because of the long period during which the SEA has been the employees' choice, as reaffirmed by last year's election, and because of the fact that Standard has not dominated or interfered with the employees' free choice of a collective bargaining agent, the company will contest the ruling of the board."

Los Angeles Demands Higher Tax

LOS ANGELES — By a unanimous vote the Los Angeles city council last week ordered the city attorney to draw up an ordinance raising the tax on petroleum products produced within the city from one-half cent a bbl. to two cents.

The new tax would net the city an additional $300,000 a year, it was estimated.


THE SYMBOL OF ADVANCED ENGINEERING
Serving the Petroleum Industry
With the Most in VALVE VALUE!
Precision workmanship, unfailing dependability, advanced engineering — these are the intangibles that spell extra valve value. And these are the qualities that have made MILVACO an honored name in the petroleum industry. Most of MILVACO'S production is still serving the needs of the armed forces, but a limited number of valves and fittings for the petroleum industry are now being produced for your more urgent requirements.
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MILWAUKEE 7, WISCONSIN
MILWAUKEE VALVE CO.

Home-Based Oil Production Is Promised By Lloyd George

Special to NPN

LONDON — Major Lloyd George, Minister of Fuel and Power, recently gave an absolute promise that Britain will establish a home-based oil production industry. A positive reply was given by the Minister in reply to a question as to whether it had been decided on economic and strategic grounds to establish an oil refining industry in the United Kingdom.

Although the scale of operations is limited to war requirements, a substantial oil refining industry already exists in Britain, but the question of post-war expansion is being kept constantly in view.

Considerable development is intended in the coal extracts industry, and already there has been substantial progress made. The development of a full scale oil refining and extracting industry is regarded as an inevitable and logical development.

Meantime the Ministry of Labor is recruiting workers for the Persian Gulf oil production and refining industry. This move is being made in connection with large-scale plans for the increased output of oil from British controlled sources in the Middle East, and for the maintenance of petroleum supplies for both Europe and the Far East.

The men wanted must be skilled electrical, mechanical, and structural engineers, under 42 years of age and physically fit. A salary of not less than 600 pounds a year with free bachelor accommodation is offered, plus free passage out and home, free medical attendance and a kit allowance. A three year contract has been offered.

The work has been described as "of the highest importance" and only the best type of skilled workers will be accepted. At least 300 men are wanted.

Signs Gas Tax Clarifier

Special to NPN

AUSTIN, Tex.—Gov. Coke Stevenson has signed a bill clarifying the Texas statute for collecting taxes on natural gas.

The bill mainly allows the state comptroller to fix a market value on gas where no price is posted. The value would be set after a hearing of interested parties.

Texans Draft Policy Charter on Oil and Gas; Ask Home Rule Except in Interstate Commerce

Special to NPN

AUSTIN, Tex. — A charter for state policy on oil and gas has been prepared by a special committee appointed by Gov. Coke Stevenson and will soon be ready for formal presentation to the governor.

Headed by James P. Nash, independent operator from Austin, the 13-member committee drew up a "statement of principles" and turned it over to Marshall Newcomb of Dallas to draft into its final form. The meeting was presided over by Olin Culberson, chairman of the Texas Railroad Commission.

Resolution adopted recommended that the state's views be presented to the Federal Power Commission through Texas Railroad Commission and industry representatives, and that the governor appoint another committee to co-ordinate evidence and argument presented in Texas' behalf before the FPC. (A Kansas City hearing by FPC soon will start to determine whether federal regulation over natural gas conservation should be broadened.)

Policy points adopted by the group included:

1. A sound policy of effective rules and laws governing petroleum regulation should be drawn.
2. Business should remain in private hands.
3. Conservation and waste are matters of concern to the industry as well as to governmental agencies.
4. State regulations should prevent physical waste, provide ratable taking, fix proper oil-gas ratios, require recycling and repressuring where wanted, and limit production to market demand. Flare gas produced with oil should find a proper place in the market. Operators and the commission should co-operate in marketing all such gas economically available.
5. Some wasteful production practices made necessary by the war can and should be discontinued quickly when peace comes.
6. Exploration of oil and gas can best be promoted by competitive effort.
7. Producers should develop repressuring and cycling projects.
8. The field of interstate commerce in oil and gas should be left to the jurisdiction of the federal government.
9. Production, processing, gathering, compressing and selling oil and gas before it enters interstate commerce are within exclusive state jurisdiction. In fixing prices, the FPC should be required to recognize the price paid in the field under bona fide contracts.
11. End use of gas should not be regulated "because competition is the best arbiter."
12. Federal authorities can assist states by recognizing the Interstate Compact Commission, continuation of the depletion allowance for tax purposes, and avoidance of duplicate taxation upon recycling and unitization projects.
13. Neither state nor federal regulation should go further than the public interest demands.

The Committee estimated that the state's reserve of natural gas, a subject of considerable controversy, is 75 trillion cubic feet. Oil and gas are inseparable and should be regulated together, the committee told the governor.

A Pressing Problem at Hand For This Oil Boom Town

Special to NPN

GLADEWATER, Texas—This East Texas oil boom town has a pressing problem on its hands that it hopes someone will clean up quickly.

The town's five dry cleaning and pressing plants, ordered by OPA to reduce their prices to 1942 levels, closed up in protest.

The local price panel appealed to the regional office in Dallas to do something about it.

Georgia Production Regulated By Three-Member Committee

Special to NPN

ATLANTA, Ga., May 21.—Governor Ellis Arnall, complying with an act of the 1945 Legislature, has appointed a three member board to regulate crude oil and gas production in Georgia.

Members of the new board include George Bazemore, Waycross banker; Joseph Pope, Wheeler County court clerk, and Paul Ploeger, Sr., Darien shrimp packer. Mr. Bazemore was elected chairman at an organization meeting.

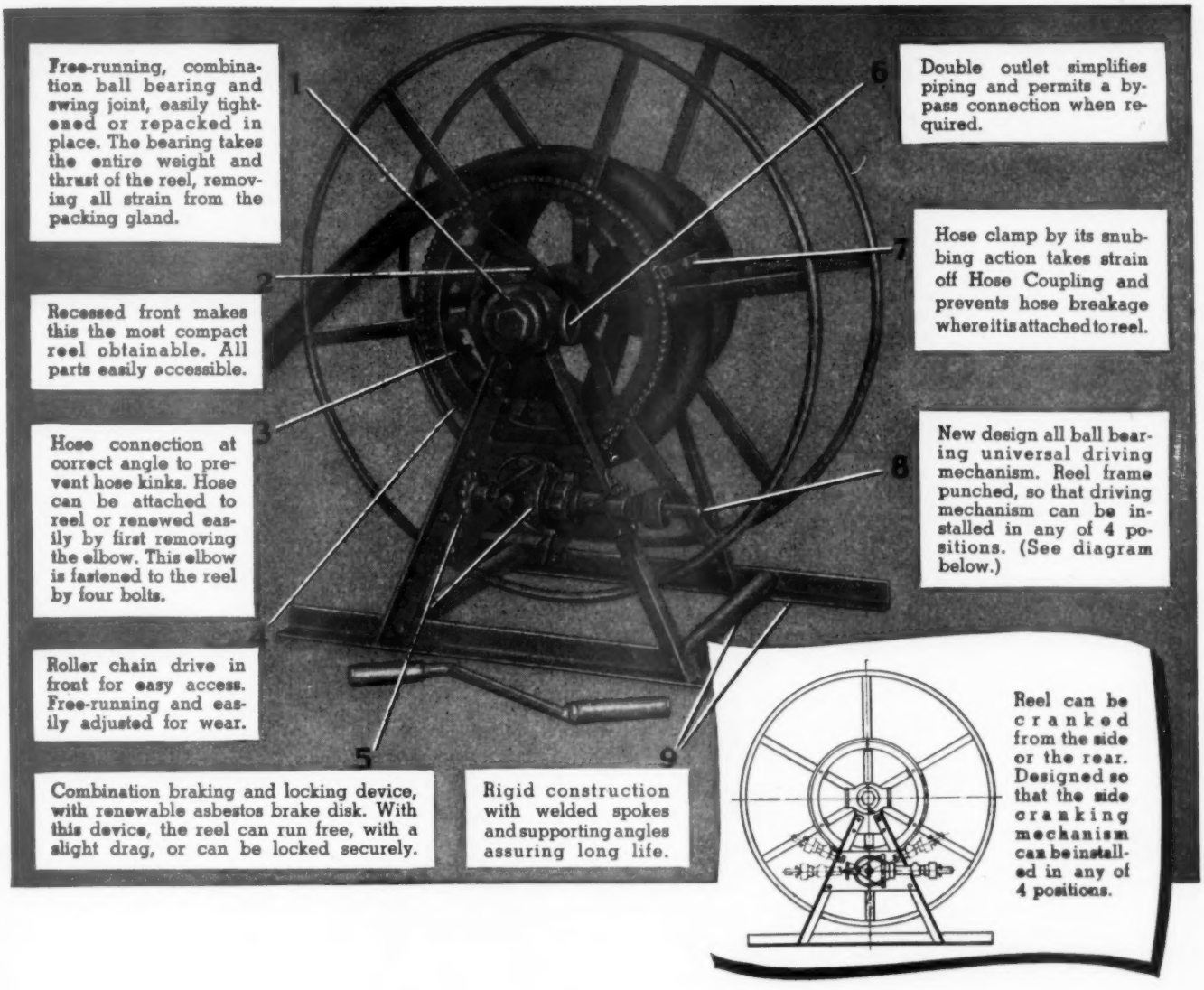
As noted, the 1945 legislative act directs this board to regulate oil well drilling, require records of drilling and soil analysis, and prevent "wildcat promotion." The board is authorized to levy a tax of five mills per barrel on oil produced in Georgia, a half mill per 1,000 cubic feet of gas, and to employ a director at a salary of $4,000.

The newly appointed committee has selected C. W. Deming, of Waycross, as director of production and conservation and ex-officio secretary of the board. A former newspaperman, Mr. Deming has edited several papers in South Georgia and at one time was an oil operator at Tulsa, Okla. He played a part in the development of Tulsa as the capital of the midcontinent field.

West Virginia Joins Compact

Special to NPN

TOPEKA, Kans.—Governor Andrew F. Schoeppel of Kansas, chairman of the Interstate Oil Compact Commission, recently announced the addition of West Virginia to the growing membership of the commission.


1
Free-running, combination ball bearing and swing joint, easily tightened or repacked in place. The bearing takes the entire weight and thrust of the reel, removing all strain from the packing gland.
2
Recessed front makes this the most compact reel obtainable. All parts easily accessible.
3
Hose connection at correct angle to prevent hose kinks. Hose can be attached to reel or renewed easily by first removing the elbow. This elbow is fastened to the reel by four bolts.
4
Roller chain drive in front for easy access. Free-running and easily adjusted for wear.
5
Combination braking and locking device, with renewable asbestos brake disk. With this device, the reel can run free, with a slight drag, or can be locked securely.
9
Rigid construction with welded spokes and supporting angles assuring long life.
6
Double outlet simplifies piping and permits a by-pass connection when required.
7
Hose clamp by its snubbing action takes strain off Hose Coupling and prevents hose breakage where it is attached to reel.
8
New design all ball bearing universal driving mechanism. Reel frame punched, so that driving mechanism can be installed in any of 4 positions. (See diagram below.)
Reel can be cranked from the side or the rear. Designed so that the side cranking mechanism can be installed in any of 4 positions.

The New Hose Reel You Have Been Looking For

COMPACT, RUGGED, LIGHT IN WEIGHT, BALL BEARING CONSTRUCTION THROUGHOUT

The new Philadelphia Valve Co. reel is the finest reel built. It is compact, rugged, and light in weight. All parts are of steel, malleable iron, or bronze; no cast iron is used. It is ball bearing throughout with hardened and ground races. (6 ball bearings are used.) It will never wear out.

The reel can be changed from top winding to bottom winding by reversing the hose connection and rotating the drum. All working parts and hose connections are in front and easily accessible. It is light in weight, a reel that holds 100 feet of 1½" hose, only weighs 93 pounds.

We can furnish hose reels in any size or shape. They can be furnished for installation either in bucket box at rear of truck or in underslung box on side of truck. Give inside dimensions of box when writing for information. Special reels can also be furnished for Airfield Refueling Pits and Ship Docks.

Delivery can generally be made in a few days after receipt of order. For sizes, prices, and dimensions, write for Catalogue No. 165.

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Postwar Export Outlook

Market Splitups May Lead to Cartels, van Bergen Fears

By Frank P. S. Glassey
NPN Staff Writer

NEW YORK—There is a "decided tendency" to split up European markets into import and distributor quotas, so far as petroleum products are concerned, and this may lead to a "virtually legalized international cartel", Charles J. M. van Bergen, vice president of Alliance Oil Corp., said here last week.

Mr. van Bergen, who is also comanaging director of the British Alliance Oil Corp., Ltd., recently returned to New York after five months in England, France and Portugal. One of the impressions he brought back was a strong distrust of plans that would make a semi-permanent division of European markets "for the benefit of a small group against a much larger group of independents and some majors."

"Right now," Mr. van Bergen said, "European markets have been and are being split up into import quotas and pools, usually based on 1938 positions. This was an excellent idea as a wartime measure to facilitate supply and transportation problems. Nevertheless, it amounted to legalizing the cartel situation

"Now, with the war in Europe over, this is uncalled for, particularly as supply and transportation problems will be gradually eased. Independent distributors abroad as well as independent refiners and marketers here are an important factor in the postwar economy. Independent suppliers here should not be shut out of these markets, nor should importers abroad be forced by policies in this country to import from some company which had them in a firm grip in prewar days.

Charles J. M. van Bergen . . . . market allocation tantamount to subsidizing cartels

"If we perpetuate the wartime system of allocation of products, it will be tantamount to subsidizing cartels."

Mr. van Bergen stressed the contention that he had no quarrel with the establishment of quotas as a war measure. But he added:

"I'm absolutely against the continuance of the quota system indefinitely, since its purpose ceased to exist with V-E Day. The industry as a whole deserves fair treatment but it will never get it if we continue a plan that mainly benefits a few large companies. We should never wittingly subject a predominantly American industry to cartel practices by regulating the channels of supply and demand.

"While it is true that some foreign Governments have acquiesced in, but not necessarily encouraged, cartel arrangements, as has recently been asserted here by some leading oil executives, it is equally obvious that our American philosophy of business cannot be furthered by either continuing to participate in such arrangements abroad or by supporting procedures of purchases abroad and supplies from this country which in effect foster cartel practices on American Industry."

Mr. van Bergen predicted that lubricating oil demand in England during the next year or two will be nearly as great as it was before the war; on the Continent he expects about 50% of prewar demand. Supplies, he said, are mainly limited to available transport.

Consumption on the Continent will rise rapidly and eventually—possibly within five years—it may exceed pre-1939 levels, Mr. van Bergen said.

Hadlick Maps Outlook For Northwest Jobbers

NPN News Bureau

CLEVELAND — Elwin E. Hadlick, president of Northwest Petroleum Assn., and a writer for the compliance service section of NPN, on May 15 in a bulletin to the members of that association "called the shots" on some changes in wartime regulations and made other predictions of interest to oil management.

Mr. Hadlick said that there would be some new passenger car production within six months but no sizable production until 1946. He said trucks would remain "tight" until 1946.

Batteries, he said, would have a production probably under 20% of estimated requirements.

He predicted a removal of convention bans by early fall and that new equipment would be available by fall.

Mr. Hadlick said that official estimates are for continued shortage of fuel oil through all the next burning season.

He called the shot on increase in gasoline rations and said: "We can hope OPA will realize the untimeliness of its institution of the Lancaster Plan."

Regulations on liquefied petroleum gases, his prediction said, will be continued in full force until the finish of the war with Japan.

"We can expect some bureaucratic 'control for the joy of controlling' in manpower, Mr. Hadlick's bulletin said, but said there should be considerable easing and that apparently decisions would be left to area or district directors.

Pointing out that some oil burners have been manufactured since Jan. 1, and that there will still be more, Mr. Hadlick said they would be of no value unless fuel oil rationing is eased.

He said that Congress would extend the life of OPA, that price controls would continue for some time without any relaxation of present policies and that taxes would continue high.

Some letup in passenger tire allowances by early fall was seen, in the face of the fact that some persons say the situation will improve very quickly. He pointed to the continued shortage of carbon black and tire cord.

A forecast of considerable improvement in manufacture of truck parts, was an encouraging note, but the Northwest jobbers were told to expect continued difficulty for some time in proper distribution.

Court Reverses Patent Award In Ashland Worker's Suit

Special to NPN

FRANKFORT, Ky.—Harvey T. Dorton's claim for $20,000 as payment for an invention used in reapplying pressure to oil wells, originally awarded him in an action against the Ashland Oil & Refining Co. by the Johnson County, Kentucky, Circuit Court, has been turned down by the Kentucky Court of Appeals.

The appellate tribunal upheld the oil company's shop rights, and said Ashland was entitled to the use of the device which Mr. Dorton says he invented alone while employed by the oil company.

Mr. Dorton's original suit was for $57,031 and a life-time job, which he asserted were promised him at the time his suggestions were carried out. He was one of a number of company employes whose combined ideas achieved the results desired, the company contended.

Fibre drums that can "take it".....Plastics for modern chairs
Handy pails for lubricants.....And cans for plums and pears
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Since we're a can company! But we're a paper container company, a fibre drum company, a crown cap company and a plastics company, too!
In fact, we're a company that's ready to supply you with practically everything in packaging and plastics products.
And though almost 20% of our men and women are now in the armed forces, production of these quality products is steadily going on. That's why, when we suggest you keep your eye on Continental and the Continental trademark, too, you have every reason to. The Triple-C means more and more to industry ... to your home.
★ ★ SALVAGE EVERY TIN CAN ★ ★
KEEP YOUR EYE ON CONTINENTAL — FOR PACKAGING AND PLASTIC PRODUCTS

HERE'S ANOTHER IN CONTINENTAL'S snappy series of ads which show you at a glance the amazing variety of articles now Continental-made. Every ad shows exactly how Continental's increased facilities can bring you better all-round packaging service than you ever had before. Look for these ads running full-color in leading national magazines —*Time, Newsweek, U. S. News, Business Week, Fortune.* Keep your eye on Continental and on the Continental trademark, too. The Triple-C stands for *one* company with *one* policy—to give you only the very best in quality and service.

OPA Has Little Luck in Local Laws to Help Enforcement; Ohio Decision Proves Setback

By Elwin E. Hadlick

About a year ago there was considerable activity on the part of OPA, through its field offices, looking to adoption by municipalities of ordinances which would support the enforcement of price and rationing regulations. That could not be properly called a campaign on the part of OPA to have local ordinances and state laws adopted. Nevertheless, considerable material was furnished to the district offices with the suggestion that these ordinances should be passed wherever possible.

Mr. Hadlick

In the article in the July 12, 1944, issue of NATIONAL PETROLEUM NEWS, the program of OPA was discussed. It was there indicated that a resort to the courts was much desirable and that industry ought to be in favor of anything that showed any signs of getting rid of OPA's administrative proceedings where OPA employes act as investigators, prosecutors, judges and juries.

It was nevertheless pointed out in that early article that there were some stumbling blocks to the successful passage of local ordinances. Some of the newspapers had expressed themselves and had raised objections, such as complaining about the Federal Government trying to load the burden of enforcement onto local police officials and concerning the effect on communities of the expenditure of their tax funds in the enforcement of OPA regulations.

In the article referred to, the question was raised whether the average municipality had the right to say that violation rules issued by agencies of the Federal Government should be considered to be a violation of municipal law.

Laws Passed in 3 States

The point was raised that courts might very well say that municipalities must limit their legislation to projects authorized in their charters or set forth in the state constitutions, also, that courts were likely to say that if a municipality did have the right to make rules concerning the use of rationing evidences or to prescribe price ceilings, it might hold that the municipality could only do so by setting out in the ordinance specifically and completely the things required to be done and for which a penalty is provided in case of failure of performance.

It was reported in that article in July 1944, that already three states had passed laws and more than 72 cities located in 11 states had adopted ordinances providing that a violation of OPA regulations was also a violation of the state law or local ordinance.

One of the ordinances which had been adopted at that time was in effect in Cleveland, Ohio, it having been on the books since June 7, 1943.

Legislative Power Limited

In due time a gentleman by the name of Piskura was convicted in the Municipal Court of Cleveland for violation of the ordinance; he promptly appealed to the next higher court, which in Ohio is known as the Court of Appeals, where the conviction was affirmed. He then went to the Ohio State Supreme Court where the conviction was set aside.

In the decision of the Ohio court there is some discussion of the legislative power which municipalities in Ohio have under the Ohio state constitution. To the extent that the court's decision may be based upon state constitutional limitations on the city's ordinance making power, the situation presented might be different from what it would be in a state where the constitutional restrictions on the municipality were lessened.

State constitutions which limit legislative powers of municipal and other local lawmaking bodies have proved a stumbling block to a move launched some time ago by OPA for local assistance in its enforcement campaign on price ceilings and rationing. In the accompanying article Elwin E. Hadlick, prominent Minneapolis attorney and marketing association executive reviews the history of this effort and in citing a Cleveland, Ohio case concludes that OPA will have to continue to carry the burden of enforcement. It is the 64th in Mr. Hadlick's series of war-oil compliance regulations.

In any event the court interprets the Ohio state constitution as granting only limited legislative power to the municipalities of that state. The court holds that the legislative bodies of municipalities can exercise powers only within the limits of those granted by the constitution.

More importantly, the court holds that legislative bodies of Ohio municipalities cannot abdicate or transfer to others the essential legislative functions with which they are invested. The court held the ordinance to be invalid on this point, because it said that when the City of Cleveland adopted an ordinance providing, that whoever sells a commodity which is the subject of a ceiling price fixedly by or under the authority of the United States of America at a price in excess of the price so established, shall be guilty of a misdemeanor, it attempted unlawfully to delegate legislative power from the City Council of Cleveland to a federal agency.

Acted Under War Powers

For persons located in other states, there is a broader basis for the decision of the Supreme Court of Ohio. It is in fact, the first point on which the court made its determination. Mr. Piskura had contended that the ordinance was repugnant to, and invaded a field controlled by the provisions of the Emergency Price Control Act; that the ordinance was unconstitutional under the Federal constitution; and lastly that the ordinance constituted a delegation of legislative power contrary to the Ohio constitution. The third contention has already been disposed of.

The Ohio court holds that the Emergency Price Control Act is enacted by Congress under the authority to declare and levy war, a field in which the Federal Government has exclusive jurisdiction. It holds that the price control act is a war measure and that nationwide rationing and price control is exclusively of a national character and can be governed only by a uniform system which is completely in the control of Congress. The court said that that being the case neither the states nor their political subdivisions have any right to legislate upon the same subject.

Frying Pan Into Fire?

There has been some indication for some little time that the enforcement agents of OPA had given up in their thoughts of having any great results come from the passage of existence of local ordinance or state laws. Possibly they woke up to the situation even before the Supreme Court of Ohio rendered its decision. It may be that to some further degree they will now forget about having local municipalities do their police work for them.

This is all well and good, but for industry and the consuming public it may be very much of a case of jumping from the frying pan into the fire. Administrative proceedings as conducted by OPA in rationing matters are not and never will be popular with the public.

Even granting the highmindedness and absolute integrity of all who are involved in administrative proceedings, the American public does not stomach a process in which the charges are presented by employes of the same department as those who reach the conclusions.

Index of Week's War-Oil Orders

(May 26 - June 2, 1945)

PAW—Petroleum Administration for War

Pri. Circular 12 as am. 4-30-45—Relation of M-293 to Pri. Reg. 18 and P-98-b

OPA—Office of Price Administration

GMPR, SR 14-I, Revocation—Former storage and terminal service price regulation replaced by MPR 583

RPS 42, Am. 7—Increase in ceiling, wax delivered east of Mississippi River

RMPR 165, Am. 9—Storage and terminal service ceilings

MPR 453, Am. 7—Wholesale and retail automotive parts ceilings

Rev. RO 5C, Am. 1—Invalidation of non-highway gasoline purchase receipts

WPB—War Production Board

L-41 as am. 5-29-45—Construction restrictions

Directions 2 and 4, Revocation—Provisions superseded by L-41 as amended

Interps. 4, 6, 10, 12, Revocation—Incorporated in Amended L-41

L-258 as am. 5-28-45—Salt and petroleum type anti-freeze solutions

M-224, Revocation—Furfural restrictions revoked

M-287, Revocation—Anhydrous aluminum chloride restrictions revoked

M-300, Schedule 108—Paraffin wax

M-340 as am. 5-26-45—Miscellaneous chemicals

CMP Reg. 5, Direction 15 as am. 5-24-45—Use of MRO symbol and rating for certain installation materials

Direction 25 as am. 5-24-45—Use of MRO ratings for reconversion

Pri. Reg. 3, Direction 3 as am. 5-25-45—Wooden crates and shipping containers

Pri. Reg. 8 as am. 5-29-45—Reports filed with WPB

DSC—Defense Supplies Corporation

Reg. 7, Rev. Schedule "A", Am. 1—Stripper well subsidy list

Dept. of Interior

Petroleum Conserv. Div. Regs. re Admin. Cong. Act of 2-22-35—Reports required of petrolem producers, storers, and transporters

NWLB—National War Labor Board

GO 30 as am. 5-23-45—Wage rates up to 55c require no Board approval

Rules of Procedure, as am.—Public members of panels appointed by Regional Boards

SPB—Surplus Property Board

Reg. 2—Govt. agency priority as to available surplus property

Special Order 9—Exemption of Dept. of Commerce from Reg. 2

WMC—War Manpower Commission

Release re Veteran Job Applicants—Relaxation of essential activity rule

Digest of Week's War-Oil Orders

Petroleum Administration for War

RELATION OF M-293 TO PRI. REG. 18 AND P-98-b—PAW Pri. Circ. 12 as am. 4-30-45—PAW will assist petroleum operators to secure critical items for which they are in competition with other industries. Newly added section of circular states that one copy of delivery order should be sent to Washington PAW Materials Division at time of placing order. Particularly critical orders should be accompanied by a memorandum describing nature of necessity. If up-rating is to be applied for, specific delivery date, required date, etc., must be supplied, with names of three alternate sources who have refused delivery by required date. Issued 4-30.

Office of Price Administration

FORMER STORAGE AND TERMINAL SERVICE PRICE REGULATION REPLACED BY MPR 586—GMPR, SR 14-I, Revocation—Issued 5-26, effective 6-1.

INCREASE IN CEILING ON WAX DELIVERED EAST OF MISSISSIPPI—RPS 42, Am. 7—Since Am. 4 allowed an increase of ½c on wax shipments from East to West Coast, this amendment allows ½c increase to Union Oil Company (Calif.) on wax delivered to Petroleum Specialties, Inc.'s bulk plants in Chicago and New York. Where freight differentials cause ceiling on a quantity over 10,000 lbs. to exceed ceiling on less than 10,000 lbs., ceiling on under 10,000 lbs. may be increased to the over-10,000-lb. ceiling. Issued 5-31, effective 6-5.

STORAGE, WAREHOUSING, AND TERMINAL SERVICES—RMPR 165, Am. 9— To conform to new storage services price order MPR 586, the reference to GMPR's jurisdiction over ceilings on storage, warehousing, and terminal services is deleted. Issued 5-26, effective 6-1.

WHOLESALE AND RETAIL AUTOMOTIVE PARTS CEILINGS—MPR 453, Am. 7—Definition of automotive parts amended to include parts primarily designed for military purposes but not sold under war contracts, which makes MPR 453 govern wholesale and retail sales of such parts to civilians. At manufacturing level such civilian sales are subject to MPR 452. Rebuilt parts include those which have only a few rebuilt or used and mostly new components. Sales by commercial, industrial, and governmental consumers are subject to MPR 453, and for used parts Sec. 7a pricing method applies (60% of retail list for usable and 30% for rebuilt parts; 42% and 21% of part's components' new list price).

INVALIDATION OF NON-HIGHWAY GASOLINE PURCHASE RECEIPTS—Rev. RO 5C, Am. 1—Non-highway gasoline purchase receipts invalid for consumer transfers beginning 7-1-45. Dealers must exchange or surrender such purchase receipts by 7-10-45, and distributors must deposit them by 7-20-45. Consumers with unexpired rations may apply for new ration in same manner as for renewal of ration. Issued 6-1, effective 6-5.

War Production Board

CONSTRUCTION RESTRICTIONS — L-41 as am. 5-29-45—Limits raised on certain types of construction: Construction of offices, banks, stores, warehouses, or other retail or wholesale service establishments raised from $200 to $5,000; factory, plant, or other industrial unit from $5,000 to $25,000, with corresponding raises for hotels, houses, etc. Maintenance and repair work on offices, stores, warehouses, etc. is limited to amount per year obtained by multiplying gross sq. ft. floor area of building by 20c. Permission for necessary maintenance or repair work costing over this amount must be obtained from WPB, unless it can be done within the appropriate annual construction allowance (given above), in which case the cost must be charged against the annual allowance. Limitations of CMP Reg. 5 and other priorities orders must be observed. Exemption of construction governed by other orders is also explained, as that under U-1 (utility services), that under any PAW administrative orders, etc. Issued 5-29.

DIRECTIONS 2 AND 4 SUPERSEDED BY PROVISIONS OF L-41, AS AM.—L-41, Directions 2 and 4, Revocation—Issued 5-29.

L-41 AS AM. INCORPORATES PERTINENT PROVISIONS OF CERTAIN INTERPS.—L-41, Interps. 4, 6, 10, and 12, Revocation—Issued 5-29.

SALT AND PETROLEUM TYPE ANTI-FREEZE SOLUTIONS—L-258 as am. 5-28-45—Only change in previous version provides that appeals shall be made by filing Form WPB-1477 in triplicate with the WPB field office for district in which plant or branch appealing is located. Issued 5-28.

FURFURAL RESTRICTIONS REVOKED—M-224, Revocation—Issued 5-29, effective 6-1.

ANHYDROUS ALUMINUM CHLORIDE RESTRICTIONS REVOKED—M-287, Revocation—Issued 5-29, effective 6-1.

PARAFFIN WAX—M-300, Schedule 108—Effective 7-1-45 paraffin wax, including low and high melting refined wax and crude scale wax, is subject to allocation as an Appendix A material. Small order exemption is 2,000 lbs. per month. Suppliers' application form is WPB-2946, to be filed by 15th of month preceding allocation. Customers' form is WPB-2945; filing date 10th of month preceding allocation. Deliveries for June may be directed on basis of proposed shipping schedules filed with WPB. By June 4 each producer must submit such schedule to WPB for June, and is restricted to such listed shipments. (PAW 5-22 wire informed producers of this requirement). Issued 5-29.

MISCELLANEOUS CHEMICALS—M-340, as am. 5-26-45—An order for a subject chemical may be certified as a "preferred order" if chemical is required to replace withdrawals from inventory within previous 30 days for preferred orders or for incorporation in material delivered for military uses. But no order may be certified as "preferred" by a purchaser for any quantity of a chemical which he can fill out of inventory without reducing it below an amount sufficient to meet expected succeeding 60-day period deliveries. Accumulation of inventories by non-preferred orders not restricted. Table of chemicals in List 1 amended to state that 90-day inventory is permitted on heat-

CODE: AO—Administrative Order; CMP—Controlled Materials Plan; D—Directive; FDO—Food Distribution Order; GMPR—General Maximum Price Regulation; GO—General Order; Interp.—Interpretation; L—Limitation Order; M—Conservation Order; MPR—Maximum Price Regulation; P—Preference Rating Order; PAO—Petroleum Administrative Order; Pri. Reg.—Priorities Regulation; Proc. Reg.—Procedural Regulation; PS—Price Schedule; RO—Ration Order; RPS—Revised Price Schedule; SO—Supplementary Order; SR—Supplementary Regulation.

OIL-LAW-Gram Service

Complete texts of all orders or amendments digested in war-oil orders can be had from Platt's Oil-LAW-Gram, 1213 West 3rd street, Cleveland 13, Ohio. Minimum charge single copies $1. Copies of these texts are always in stock but large orders can be promptly filled by reprinting as plates and stencils are also kept.

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treated, stabilized, polymerized and gum and wood rosins, and on metal resinates. No preferred purpose listed for oxidized petrolatum. enamelwire naphtha, or hi-flash naphtha. Issued 5-26.

USE OF MRO SYMBOL AND RATING FOR CERTAIN INSTALLATION MATERIALS—CMP Reg. 5, Direction 15 as am. 5-24-45—Installation of machinery or equipment under Direction 2 of L-41 may use building materials priority MRO symbol and rating assigned to business in which equipment will be used. Businesses not listed on Schedule A assigned AA-3 rating for up to $500 worth of building materials. If construction under L-41 is not involved, priorities assistance assigned the business by CMP 5 or any U or P order may be employed for $500 worth of materials. Issued 5-24.

USE OF MRO RATINGS FOR RECONVERSION—CMP 5, Direction 25 as am. 5-24-45—Permits use of MRO ratings under CMP Reg. 5 for MRO supplies and jigs, dies and fixtures for reconversion where manufacturer is starting to make a product not now made by him. Purchases must be charged against MRO quota. Persons setting up completely new businesses or plants after 2-28-43, and who were not in business in 1942, are automatically entitled to a quota of $5,000 per quarter under CMP Reg. 5. This special quota does not apply when an established plant starts producing a new product, since the quota restrictions are on a plant, and not on a product basis. Issued 5-24.

WOODEN CRATES AND SHIPPING CONTAINERS—Pri. Reg. 3, Direction 3 as am. 5-25-45—Containers made in captive plants no longer excluded from MRO assistance under Direction 3. Limit of 50.000 board feet of lumber for any type of plant remains. Issued 5-25.

REPORTS FILED WITH WPB—Pri. Reg. 8 as am. 5-29-45—Implements authority of WPB to require from businesses any reports it finds necessary. Failure to do so is a violation of Pri. Reg. 8 and of any other regulation or order requiring such report. Among safeguards against unnecessary reports is requirement of Bureau of Budget approval. Issued 5-29.

Defense Supplies Corporation

STRIPPER WELL SUBSIDY LIST—DSC Reg. 7, Rev. Schedule "A", Am. 1—Specifies additions to (18), changes (1), and deletions from (4) subsidy list. Issued 5-15.

Dept. Of Interior

REPORTS REQUIRED OF PETROLEUM PRODUCERS, STORERS, AND TRANSPORTERS—Petroleum Conservation Div. Regs. re Cong. Act of 2-22-35—Board may direct, in writing, that producers, refiners, reclamations plants, etc. shall, within 30 days of service of an order, furnish board with diagrams, accurate as to scale, showing location of each lease, location and number of each well, location, capacity, and identifying numbers of all tanks, location and size of pipe lines, flow lines, and gathering systems, operated by a producer and location and sizes of pipe lines, flow lines, gathering systems, and other outlets attached to his property, and every method by which oil is or can be delivered to and from his properties. Issued 5-3, approved 5-29.

National War Labor Board

WAGE RATES UP TO 55c REQUIRE NO BOARD APPROVAL—GO 30 as am. 5-23-45—Increases above 50c per hr. made hereunder, may not furnish a basis to increase or to resist reduction in price ceilings. Issued 5-23.

PUBLIC MEMBERS OF PANELS APPOINTED BY REGIONAL BOARDS—Rules of Procedure, as am.—Hearing officers, arbitrators, and public members of tri-partite panels are appointed by regional boards and commissions. They shall be proposed by the Chairman of the Board, or a person designated by him, and prior to appointment shall be approved by industry and labor members of the regional board or commission. Issued 5-21, filed 5-26.

Surplus Property Board

GOVT. AGENCY PRIORITY AS TO AVAILABLE SURPLUS PROPERTY—Reg. 2—Government agencies and state or local governments have priorities to acquire surplus property, subject to the lengthy rules outlined in Reg. 2. Issued 4-24, published 5-8, effective 5-25.

EXEMPTION OF DEPT. OF COMMERCE FROM REG. 2—Special Order 9—Dept. of Commerce is exempted from Reg. 2, *described above* in consideration of its representation that if orders are received from such government agencies for property subject to surplus property sales, it will make every reasonable effort to fill such orders from like property which it may have in other inventories or may acquire in the future. Exemption applies to agricultural machinery and implements, construction and maintenance equipment and machinery, tractors, portable roadworking and repairing machinery, advertised on or before 5-25-45, for disposal at sales which were announced on or prior to 5-15-45, and to all other property listed in SPB Reg. 2's Exhibit A for which Dept. of Commerce is disposal agency, announcement of sale of which was made on or before 5-15-45. Issued 5-22, effective 5-25.

War Manpower Commission

RELAXATION OF ESSENTIAL ACTIVITY RULE—Release re Veteran Job Applicants—USES will accept and process, for interoffice recruitment, job orders from employers specifying their wish to employ veterans, even though such employers may be engaged in work of a less essential nature than formerly demanded by USES. But no such orders will be accepted if qualified veterans or non-veterans are available in local labor market. Changes in present standards mean: Employer's order need not warrant assignment of a manpower priority rating; the local USES will be free to clear such orders in any community where veterans may be available; when a request for fewer than 10 workers is involved, employer does not have to send a hiring representative or subscribe to advertising at recruitment points. USES will first inform veteran applicants of higher priority jobs, and if not accepted by veterans, lower or non-priority jobs will be offered. Issued 5-31.

Halts Los Angeles Suspension Order for Station Appeal

NPN News Bureau

LOS ANGELES — Federal Judge Leon R. Yankwich of the United States District Court in Los Angeles last week ordered OPA to stay suspension orders against Edward Fenton, service station operator, pending decision on an appeal now before OPA in Washington.

OPA officials had refused to stay their suspension order until a decision could be reached in Washington so Fenton, who allegedly accepted 250 counterfeit gasoline coupons out of 30,000 which he took in over a period of six months, carried his appeal for a stay of execution to the federal court.

In his decision, the judge said:

"Closing of the plaintiff's business by the order of April 18, 1945, would in effect abolish plaintiff's business before his appeal may be heard and determined.

"To suspend the plaintiff from doing business while his appeal is pending is to deprive him of his right of appeal."

Asks Stiffer Penalties In New Patent Bill

NPN News Bureau

WASHINGTON—The Department of Justice endorsed the Boykin Bill (H.R. 2632) to require recording of agreements relating to patents, but urged that stiffer penalties be applied in cases of "flagrant secrecy" involved in international patent agreements which have been "extant for a number of years."

The proposal was made by John Stedman, in charge of patent work in the department's claims division, who testified before House Patents Committee.

The committee currently is conducting hearings on three patent measures offered by Rep Boykin (D., Ala.).

Referring to penalties provided for in sub-section 4, Sect. 1 of the Patents Recording Bill (H.R. 2632)—including a fine of not more than $500 for failing to register, and not more than $25 for each day the infraction is continued—Stedman told the committee.

"These penalties might be all right in ordinary cases, but probably not in cases of flagrant secrecy in international (patent) agreements which have been extant for a number of years."

Other Suggestions

Other suggestions made by Stedman were as follows:

1. A copy of each agreement made in connection with patents should be filed with the Attorney General "if the committee deems it feasible." However, he readily agreed that this was a "secondary" point when Chairman Boykin, Rep. Bailey (D., W. Va.) and other committee members said they believed such matters could be better handled on the "executive level"—by understanding between the attorney general and the Patent Office—than by a mandate of Congress.

2. It might be possible to include in the measure a statement that no seller of patents who has acted in good faith in disposing of his patents should be subject to the penalties of the bill. (As it now stands, the bill subjects the seller to penalties for failure to record patent agreements with the buyer or licensee).

Stedman said he "assumed" that, merely because a person files patent agreements under the bill, he is in no way immunized from the provisions of the anti-trust laws. Boykin and Rep. Bailey assured the witness that no such immunity was contemplated.

British Oil Diplomat to Go

NPN News Bureau

WASHINGTON—Ben Smith, British minister resident for supply in Washington, who aided in negotiation of Anglo-American Oil Agreement, has relinquished his appointment and is returning to London to seek re-election to Parliament.

He has been coordinating British policy on war supply and procurement matters here since December, 1943.

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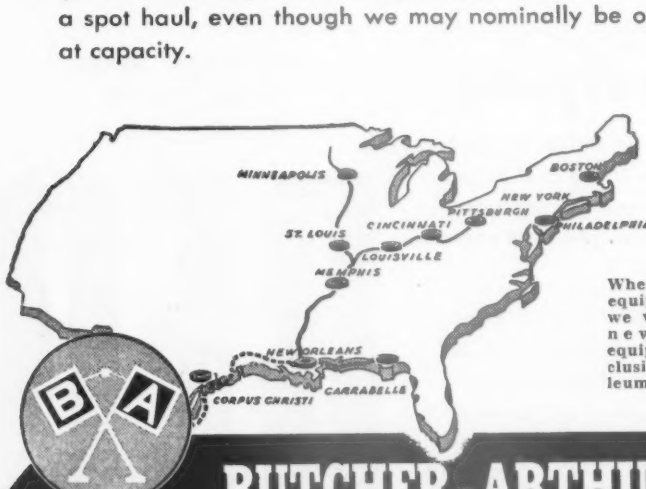

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Battle Lines Forming On OPA Extension

NPN News Bureau

WASHINGTON—Battle lines over the OPA extension bill were forming this week on the Senate floor after the Senate Banking Committee reported favorably on the measure proposing a one-year lease on life for the price and rationing agency.

The committee's majority under Chairman Wagner (D., N. Y.) praised OPA and urged continuance of the agency for another year without restrictive amendments, asserting that, while one nation after another has succumbed to inflation, OPA "has held the rise in the cost of living in the United States to a bare 1.6% in the two years from May, 1943, to May, 1945.

"Industrial prices here have risen only 2.6% in the same period," it added.

Minority Points to High Earnings

A vigorous answer to that contention was made in minority report. Complete success was not attained by OPA's "freeze" policy, the minority contended, because it has not held the line on average hourly earnings, which have risen 12% in the same period, and because the agency's program has included some payment of subsidies.

While recommending that OPA be continued for a "reasonable period," the minority urged adoption of two amendments relaxing price control authority. One, by Sen. Thomas (D., Okla.) would prohibit OPA from requiring anyone to sell below his cost of production. The other, offered by Sen. Taft (R., Ohio) would require the agency to restore prewar profit margins after Oct. 1, 1945.

Bowles Opposes Short Term

OPA Administrator Bowles appeared, meanwhile, before the House Banking Committee to urge that group to follow the lead of the Senate majority in approving extension of price-control law, without "crippling amendments" for another year. He warned against a shorter extension—say for six months—contending that such legislation would only prompt business to start buying up materials for stockpiling against the day when "the lid would be taken off." In addition, Mr. Bowles stated his case against proposals embodied in the Taft and Thomas amendments.

"These proposals to require a profit for every seller or, more plausibly, for sellers, generally, a profit on each separate product, would compel widespread price increases," he said. "These price increases would be cost increases to other firms which, in turn, would require further price increases. They would set the stage for wage increases and, hence, still more price increases."

In defense of the amendments the Senate minority report contended they would "bring assurance to our economy and a protection in law upon which we can rely."

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REPLACEMENT COST ISSUE IN CRUDE HEARING

(*Continued from p.* 3)

such figures are ultra-conservative and have resulted in crediting to former years a minimum of 1½ billions of barrels of crude reserves each year.

"The conservative basis of industry reporting is certainly satisfactory for the reasons for which it was devised, but it is not factual enough for a price control agency to make far-reaching decisions involving the price of oil. It is safe to assume on the basis of past experience that the actual reserves found by exploratory efforts in 1944 will not be known with any great degree of accuracy for a period of at least five to ten years in the future. Therefore, this agency does not feel it can pass judgment on oil prices on such an inaccurate basis."

'Gross Return' To Be Base

Mr. Judd added OPA would take producers' expenditures as against their gross return this year and in subsequent years, and if it is found that their net position is not as good as it was in the 1936-39 base period, "we will grant price increases which will permit that net position to be brought to that level. We have felt that such a position is in accordance with the mandates of Congress."

In reply to the congressman's second question, Mr. Judd said no member of the committee would be permitted to work with the OPA staff on cost figures received from individual producers, because these must be kept in strict confidence, but that OPA had agreed to submit to the committee "any totals on any divisions of the industry and to advise them as to any methods we employ in making our computations."

Four days later, the Texan wrote Mr. Judd that he could not make sense out of the statement that OPA does take replacement costs into consideration but not on the basis of estimated reserves found. Further, if OPA construed replacement costs to mean only production costs—in considering only actual dollars received by the industry for production sold—"then you have not actually given any weight to the increase in finding or exploration cost," Mr. Patman asserted, and continued:

Approach Termed Wrong

"As I understand the effect of your policy, you will consider finding or exploration costs as a part of the total expenditures of the companies and compare that with the total income for the company for the same period, and if there remains a margin of profit, you consider that prices need no adjustment. To me this is not the proper approach to the problem.

"I have been informed and have reason to believe that in the case of many independent producers the production costs as of today are approximately 200 per cent of the amount they were in 1941. The cost of developing such new reserves as have been found will vary with the nature and extent of the discoveries but in all cases has materially increased.

"Liquidating at Higher Rate"

"The total income of the same companies has increased approximately 10%, but such increase is due almost entirely to an accelerated rate of production, which means that these companies are liquidating their assets at an increasing rate. The amount, therefore, that is left for exploration is becoming increasingly less and, if the same continues, will be reduced to nothing.

"In view of the expressed desire on the part of the president, the PAW, and other responsible officials, that exploration should be conducted with increasing vigor, calling for the expenditure of larger amounts of money, it is my opinion that a price policy which does not tend in this direction is unsound."

Mr. Patman said that the profit per barrel made by the independent producer is now considerably less than it was at the time the maximum price of crude was established, adding: "I am sure you are concerned with the prevention of inflation to the same extent that we all are, and it is not our desire to increase the amount which the consumer must pay for any commodity. However, it is my opinion that if a new ceiling were set for crude oil, the only result of such action on your part would be to permit an adjustment as between the independent producer and the integrated companies."

Any change in prices, Mr. Patman said "will be gradual and will take place only to the extent that the purchasing companies can afford to increase the price they pay for the crude they do not themselves produce."

As to the difficulty of OPA in estimating crude reserves and its refusal to give any weight to this angle in fixing crude prices, Mr. Patman pointed out that PAW considers and accepts the findings of Petroleum engineers as to reserves for the purpose of allocating nation-wide production and the Securities and Exchange Commission, in permitting sales of securities, and banks in making large loans to oil operations, "not only accept these estimates, but require them." "Why then," he asked, "should not OPA accept these accepted standards and practices?"

On April 17, Mr. Judd further detailed OPA's "replacement costs" position, stating that the industry had requested that OPA use operating cost figures in a manner shown by their books "but that the finding and development costs which their books show should be disregarded and that we substitute figures calculated on a different basis."

"For finding costs," he added, "we are requested to substitute an estimate of the cost of finding oil today, and to apply this cost to every barrel of oil being lifted today, regardless of what was actually spent to find this oil. We are requested to use a similar principle with respect to developmental costs. To grant this request of industry and raise the ceiling prices accordingly would introduce into wartime price control a direct relationship between replacement cost and price which never existed in peacetime."

To permit a price increase by giving effect to increased labor and material costs, "without regard to the ability to absorb," Mr. Judd added, "would, of course, result in pure 'cost-plus' pricing which would stimulate the cost-price inflationary spiral the stabilization legislation was intended to prevent."

In conclusion, Mr. Judd wrote that OPA intended "to continue to give the oil industry every consideration to which it is entitled," adding: "We believe that every segment of the industry should be as free from control as is consistent with the purposes of the anti-inflation program. Such purposes require that standards of general applicability be established and adhered to in dealing with all industries. The petroleum branch must conform to the standards in general use throughout the agency. We desire the present survey to permit a factually accurate determination of the fairness and equity of the present maximum prices."

Mr. Patman apparently found that this last letter from OPA did not satisfy him, for in reply he said that when he had had an opportunity "to digest" Mr. Judd's letter, "I shall contact you again on this matter." The contact, it seems, was a request to appear before the committee this month when the primary question of replacement costs will be threshed out in open hearings.

Coming Meetings

OCTOBER

Indiana Independent Petroleum Assn., fall convention, Hotel Severin, Indianapolis, Oct. 10-11.

DECEMBER

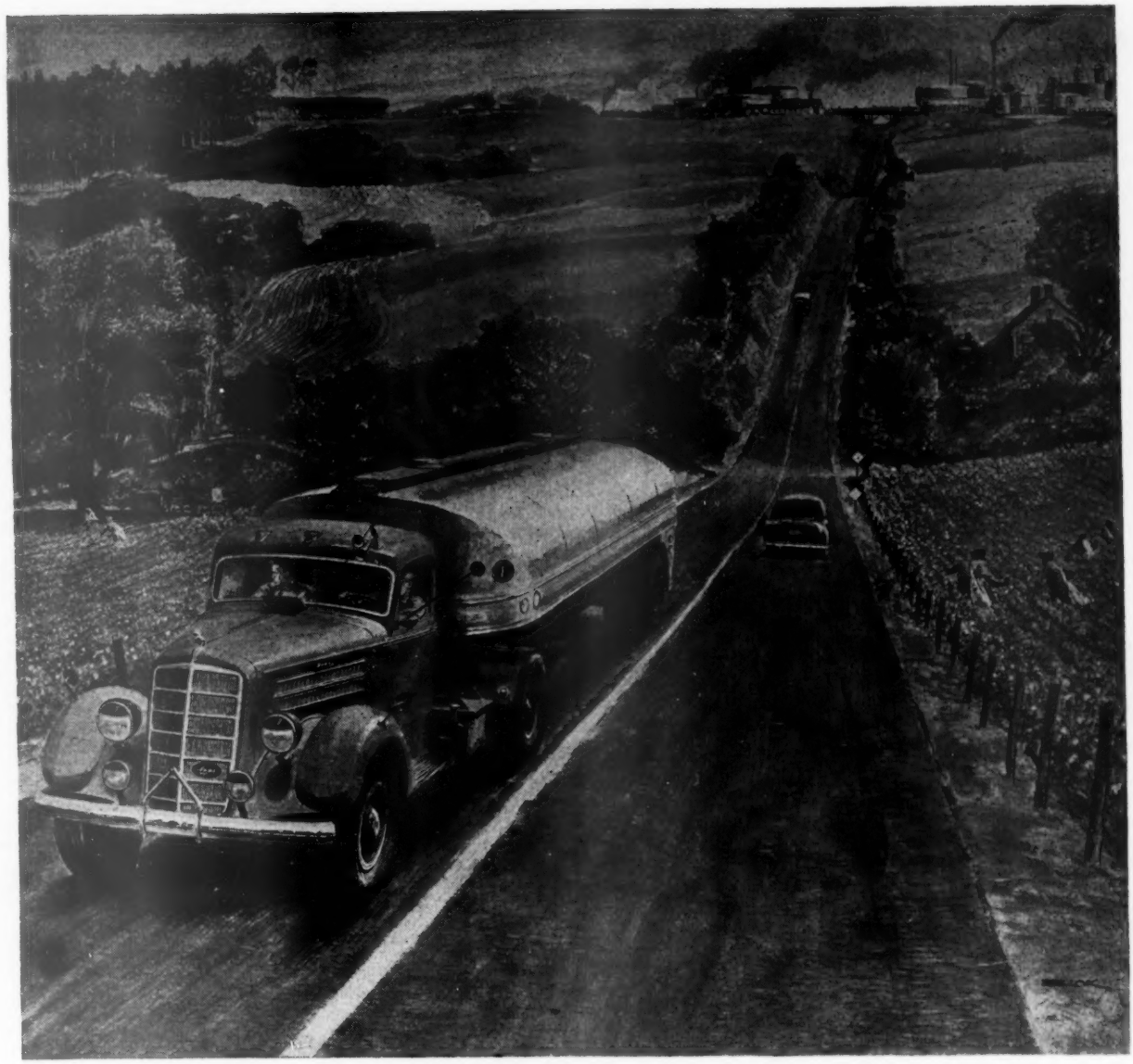
Nebraska Petroleum Marketers, Dec. 4-5-6.
Wisconsin Petroleum Marketers, Dec. 11-12.

Cites Indiana Oil Men's Need In Plane Service Appeal

Special to NPN

EVANSVILLE, IND.—Petroleum interests in Illinois, Kentucky and Indiana with offices in Evansville require additional plane service to the Southwest, Walter G. Koch of the Evansville Air Board told the Civil Aeronautics Board last week at a meeting in Greensboro, N. C.

In a long brief he urged that American Air Lines be granted the right to put Evansville on a proposed route which would add six daily flights to and from the municipal airport. Two aviation lines are now operating here, Chicago & Southern and Eastern Airlines.



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TRACTOR FUEL — DIESEL FUEL
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WOOD RIVER OIL AND REFINING COMPANY, INC.

A Pump You Can TRUST Because

BLACKMER "BUCKET DESIGN"

Means

SELF-ADJUSTMENT FOR WEAR...
ECONOMY YOU NEVER EXPECTED

FOR HANDLING

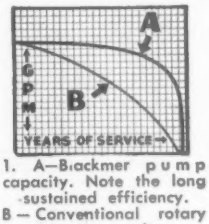
GASOLINE CRUDE OIL	BUTANE FUEL OIL	LUBE OIL NAPHTHA
BULK STATION PUMPS	TRUCK PUMPS	HAND PUMPS
50 to 750 G.P.M.	35-50-90 G.P.M.	1½ to 25 G.P.M.
Single or twin	Double bearings	Barrel or tank

Write for Bulletin No. 102—Pumps for the Petroleum Industry

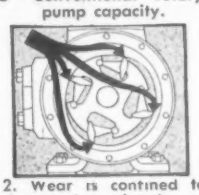
BLACKMER PUMP COMPANY
1880 Century Avenue — Grand Rapids 9, Michigan

SERVING THE PETROLEUM INDUSTRY FOR 40 YEARS

The drawings show you why—



1. A—Blackmer pump capacity. Note the long sustained efficiency. B — Conventional rotary pump capacity.



2. Wear is confined to these points; the tips of the buckets, which automatically compensate for wear.

3. This much of a bucket can wear away without affecting the capacity of the pump.

4. When finally worn out, the buckets are easily replaced (a 20-minute job) and the pump restored to normal capacity.

National Petroleum News

Established February, 1909

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ADVERTISERS' INDEX

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American Flange & Mfg. Co., Inc. 19
Birmingham Tank Co. 34
Blackmer Pump Co. 48
Brown Steel Tank Co. 21
Butcher-Arthur, Inc. 44
Can Manufacturers' Institute 33
Chicago Bridge & Iron Co. 2-3
Continental Can Co. 29
Crown Can Co. 15
Erie Meter Systems, Inc. ..... Inside Front Cover
Ethyl Corp. 1
Farrell Mfg. Co. ..... Inside Back Cover
Fruehauf Trailer Co. 28-29
Gulf Oil Corp. 17
Kellogg Co., M. W. 22-23
Lees-Bradner Co. 25
Mack Mfg. Corp. 47
Mearl Corp. 45
Milwaukee Valve Co. 35
Paraflow-Stanco Distributors, Inc. 31
Philadelphia Valve Co. 37
Reo Motors, Inc. 43
Sun Oil Co. ..... Outside Back Cover
Time, Inc. 27
Wood River Oil & Refining Co., Inc. 48

Market Reports

ATLANTIC COAST — No price changes were reported. Suppliers of gasoline in New York generally reported receiving ample pipeline deliveries of gasoline to fill contract orders, although tank car deliveries were tight.

GULF COAST — No price changes A gulf refiner said he anticipated a bottleneck in 100-octane movement, due to tank car shortage, but barge shipments were showing some improvement. All products were reported tight and with all materials under PAW assignment no spot sales are being made at the Gulf. Gasoline continued tight, especially Ethyl, since supplies of tetraethyl lead are extremely short, said one refiner.

CALIFORNIA — The gasoline market was reported steady with extreme bottom range remaining at 5.75c, 7c, and 8c for the three grades. Demand for heating oil has slackened somewhat, but Diesel fuel still was in short supply. No price changes were reported.

MIDWEST — No price changes reported. One refinery reported success in obtaining limited purchases of kerosine but was unable to obtain any amount of light fuels.

After a brief let-up the Midwest was once more off-season as rains descended again this week, making the farmers idle, as they have been forced to be most of this season. Refiners and marketers anticipated increase in demands, said to come with the fair weather, have also been postponed.

It was reported this week that bright stocks are even tighter than they have been but that there has been a slight ease in the demand for Penn neutrals.

Transportation seems to be running smoother, with that sporadic condition reported a short time ago gradually disappearing. Still not the least of refiners worries, operators seem to have become accustomed to critical transportation.

MIDCONTINENT—Prices in this area continue unchanged at current posted levels. Several refiners using pipeline facilities for gasoline shipment have reported the lines to be over-crowded and the demand still heavy. Floods in northern Kansas have held up demand for farm products and extremely dry weather in north Texas is currently harassing refiners and farmers in that area.

An Oklahoma refiner said he was four or five days behind on shipments of Stoddard solvent and mineral spirits.

No open spot sales were reported on Grade 26-70 natural gasoline but refiners quoted 4.5c f.o.b. Group 3 and 4.125-4.375c f.o.b. Breckenridge throughout the week.

PENNSYLVANIA—News for neutrals oils continue to be prime factor in tight supply of motor oils. Although bright stocks were reported slightly easier during week, demands for neutrals continued in excess of available supply. Local shortage of light fuels were noted in the upper field, while industrial consumers made heavy inquiries for Nos. 1 and 2 oils. No price changes were reported.

N.P.N. Gasoline Index

	Dealer T.W.	Tank Car
	Cents Per Gal.	
May 28	10.27	6.72
Month ago	10.39	6.72
Year ago	10.51	6.88

Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

Tank car index is weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

Daily Av. Pennsylvania Crude Runs

(Compiled by National Petroleum Assn. from reports of all companies refining Pennsylvania crude. Figures in bbls.)

Week Ended May 26, 1945	Week Ended May 19, 1945	Week Ended May 27, 1944
57,516	54,795	66,880

Augusta Field Spacing Relaxed

NPN News Bureau

CHICAGO—Spacing for wells above the base of the Kansas City lime about 2200 ft. in the Augusta Field, Butler County, Kansas, was relaxed from 20 to 10 acres, under authority of PAW Dist. 2 administrative letter No. 62 issued May 29, by C. C. Brown, District Director of Production.

CRUDE PRICES

Since changes in crude oil prices are so few, the two pages of crude oil price tables hereafter will be printed only when there are sufficient changes in prices to warrant.

In the meantime a record is being kept in the Cleveland office of NPN and OILGRAM from which the publishers will be glad to make proofs, or letters or affidavits as to what the prices are, and without charge to regular subscribers. Changes in crude oil prices will be specially noted in this market section when made.

Crude Price Changes

No price changes for week ending May 30.

For latest table of crude prices published, see NPN May 30, pages 57, 58 and 55.

Summary of Daily Gasoline Prices (May 28 to June 4)

	Monday June 4	Friday June 1	Thursday May 31	Wednesday May 30	Tuesday May 29
U. S. Motor (ASTM octane)					
76 octane Ethyl:					
Oklahoma	6.75	6.75	6.75	6.75	6.75
Mid-Western (Group 3 basis)	6.75	6.75	6.75	6.75	6.75
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7	7	7	7	7
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7 (2)	7 (2)	7 (2)	7 (2)	7 (2)
70-74 octane:					
Oklahoma	5.875	5.875	5.875	5.875	5.875
Mid-Western (Group 3 basis)	5.875	5.875	5.875	5.875	5.875
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.875	5.875	5.875	5.875	5.875
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.875	5.875	5.875	5.875	5.875
63-66 octane:					
Oklahoma	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)
Mid-Western (Group 3 basis)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)
W. Tex (For shpt. to Tex. & N. M. dest'ns.)	5.625 (2	5 625 (1)	5.625 (1)	5.625 (1)	5.625 (1)
60 octane & below:					
Oklahoma	5.25	5.25	5.25	5.25	5.25
Mid-Western (Group 3 basis)	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.25	5.25	5.25	5.25	5.25
Motor Gasoline, 70-74 oct.					
New York harbor	9.075	9.075	9.075	9.075	9.075
New York harbor, barges	8.5 - 8.	8.5 - 8.975	8.5 - 8.975	8.5 - 8.975	8.5 - 8.975
Philadelphia district	9.075	9.075	9.075	9.075	9.075
Baltimore district	8.825	8.825	8.825	8.825	8.825
Motor Gasoline:					
Western Penna. Bradford-Warren:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.625- 8.225	7.625- 8.225	7.625-8.225	7.625- 8.225	7.625- 8.225
Western Penna. Other Districts:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.725	7.725	7.725	7.725	7.725

Note: To conform with Article IV of MPR 88 as amended August 15 we are substituting 70-74 oct. ASTM for the old 72-74 oct. ASTM. We continue to include in this group, Housebrand quotations.

REFINERY OPERATIONS

(American Petroleum Institute figures in thousands of barrels of 42 gal. each. Figures include reported totals plus estimate of unreported amounts and are therefore on a Bureau of Mines basis.)

Districts	Daily Average Crude Runs to Stills Week Ended		Gasoline Production at Refineries inc. Natural Blended Week Ended		Kerosine Production Week Ended		Gas Oil & Dist. Fuel Oil Production Week Ended		Residual Fuel Oil Production Week Ended		Total Stocks Kerosine Week Ended	
	May 26	May 19	May 26	May 19	May 26	May 19	May 26	May 19	May 26	May 19	May 26	May 19
East Coast	732	715	1,748	1,886	186	180	715	953	1,629	1,577	2,722	2,652
Appalachian (Dist. 1)	104	98	284	277	62	62	72	76	96	83	265	246
Appalachian (Dist. 2)	65	66	174	203	11	12	37	39	103	100	44	46
Ind., Ill., Ky.	788	801	2,925	2,944	190	216	718	660	1,074	1,112	1,288	1,302
Okla., Kans., Mo.	393	403	1,448	1,465	181	187	451	501	499	492	609	656
Inland Texas	257	255	1,046	992	94	91	112	117	485	483	215	206
Texas Gulf Coast	1,188	1,176	3,696	3,645	439	434	1,487	1,656	1,807	1,904	1,334	1,153
Louisiana Gulf Coast	267	248	918	812	222	184	314	285	359	368	1,014	1,016
No. La. & Arkansas	74	84	219	248	40	46	39	66	111	126	223	148
Rocky Mt. (Dist. 3)	12	12	38	39	4	5	7	7	24	24	20	20
Rocky Mt. (Dist. 4)	111	105	379	400	14	16	100	99	248	225	101	103
California	959	945	2,319	2,358	6	113	615	582	3,235	3,152	411	407
Total U. S.—B. of M. Basis	4,950	4,908	15,194	15,269	1,449	1,546	4,667	5,041	9,670	9,646	8,246	7,955
U. S.—B. of M. Basis May 27, 1944	4,561		13,362		1,609		4,905		8,434		7,744	

Districts	Total Stocks Gas Oil and Distillates Week Ended		Total Stocks Residual Fuel Oil Week Ended		Gasoline Stocks—*Military and Other** Week Ended		Gasoline Stocks—Civilian Grade Week Ended	
	May 26	May 19	May 26	May 19	May 26	May 19	May 26	May 19
East Coast	5,923	6,195	5,575	5,818	5,477	5,783	8,126	7,818
Appalachian (Dist. 1)	344	334	198	185	1,132	1,112	1,229	1,224
Appalachian (Dist. 2)	96	95	136	147	382	548	1,122	891
Ind., Ill., Ky.	3,939	3,950	1,888	1,805	7,113	6,872	14,667	14,898
Okla., Kans., Mo.	1,690	1,837	1,146	1,152	2,219	2,117	7,048	7,168
Inland Texas	365	320	823	825	1,200	1,217	1,732	1,722
Texas Gulf Coast	6,135	6,111	5,909	5,947	9,108	9,330	4,573	4,620
Louisiana Gulf Coast	1,517	1,555	1,429	1,436	2,349	2,562	2,114	2,021
N. La. & Arkansas	714	662	197	202	584	533	2,098	2,255
Rocky Mt. (Dist. 3)	21	20	35	33	20	20	56	56
Rocky Mt. (Dist. 4)	275	278	592	591	658	608	1,724	1,777
California	8,165	8,113	20,620	20,483	10,614	10,607	3,776	3,914
Total U. S.—B. of M. Basis	29,184	29,470	38,548	38,624	40,856	41,309	48,265	48,364
U. S.—B. of M. Basis May 27, 1944	32,074		50,617		37,967		48,296	

*Includes aviation and military grades, finished and unfinished, title to which still remains in the name of the producing company; solvents, naphthas, blending stocks currently indeterminate as to ultimate use, and 11,390,000 bbl. unfinished gasoline this week, compared with 12,106,000 bbl. a year ago.

**These figures do not include any gasoline on which title has already passed, or which the military forces may have actually in custody in their own or leased storage.

Percent Daily Refining Capacity Reporting—East Coast, 99.5; Appalachian (Dist. 1) 76.8, (Dist. 2) 81.2; Ind., Ill., Ky., 87.2; Okla., Kans., Mo., 78.3; Inland Texas, 59.8; Texas Gulf Coast, 89.3; Louisiana Gulf Coast, 96.8; No. Louisiana & Arkansas, 55.9; Rocky Mt. (Dist. 3) 17.1, (Dist. 4) 72.1; California, 85.8; Total U. S.—B. of M. Basis May 26, 1945 85.6; Total—B. of M. Basis May 19, 1945 85.6.

U. S. Crude Oil Production

(American Petroleum Institute figures)

	WEEK ENDED Barrels (Daily Average) May 26, 1945	Barrels (Daily Average) May 19, 1945
Oklahoma	*385,700	385,400
Kansas	*275,100	271,300
Nebraska	*900	900
Texas	2,176,150	2,176,150
Louisiana	370,050	370,900
Arkansas	80,000	79,850
Mississippi	49,800	49,800
Alabama	450	450
Florida	15	15
Illinois	195,950	194,650
Indiana	12,550	12,450
Eastern (Ill. Ind. & Ky. excluded)	63,000	64,950
Kentucky	27,700	26,850
Michigan	46,600	45,800
Wyoming	107,400	106,950
Montana	20,300	20,850
Colorado	11,000	11,200
New Mexico	103,900	103,900
California	940,200	945,100
Total, U. S.	4,866,765	4,867,465

*Okla., Kans., Neb. figures are for week ended 7:00 a.m. May 24, 1945.

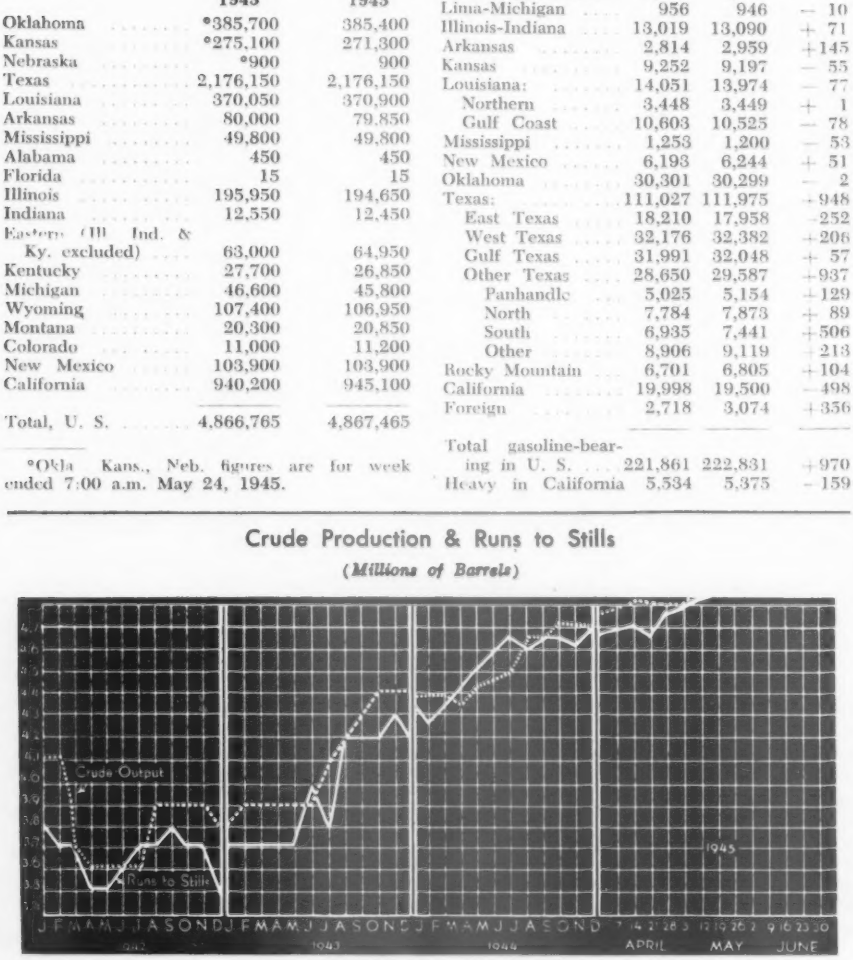
Crude Oil Stocks

(Bureau of Mines Figures in thousands of bbls.)

Grade or Origin	May 19	May 26	Change from May 19
Penna. Grade	2,199	2,207	+ 8
Other Appalachian	1,379	1,361	— 18
Lima-Michigan	956	946	— 10
Illinois-Indiana	13,019	13,090	+ 71
Arkansas	2,814	2,959	+145
Kansas	9,252	9,197	— 55
Louisiana:	14,051	13,974	— 77
Northern	3,448	3,449	+ 1
Gulf Coast	10,603	10,525	— 78
Mississippi	1,253	1,200	— 53
New Mexico	6,193	6,244	+ 51
Oklahoma	30,301	30,299	— 2
Texas:	111,027	111,975	+948
East Texas	18,210	17,958	-252
West Texas	32,176	32,382	+206
Gulf Texas	31,991	32,048	+ 57
Other Texas	28,650	29,587	+937
Panhandle	5,025	5,154	+129
North	7,784	7,873	+ 89
South	6,935	7,441	+506
Other	8,906	9,119	+213
Rocky Mountain	6,701	6,805	+104
California	19,998	19,500	-498
Foreign	2,718	3,074	+356
Total gasoline-bearing in U. S.	221,861	222,831	+970
Heavy in California	5,534	5,375	- 159

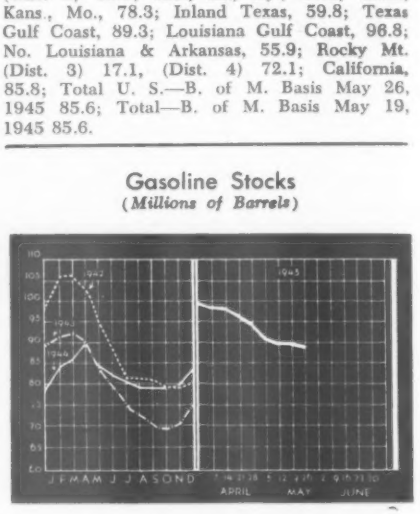
Crude Production & Runs to Stills

(Millions of Barrels)



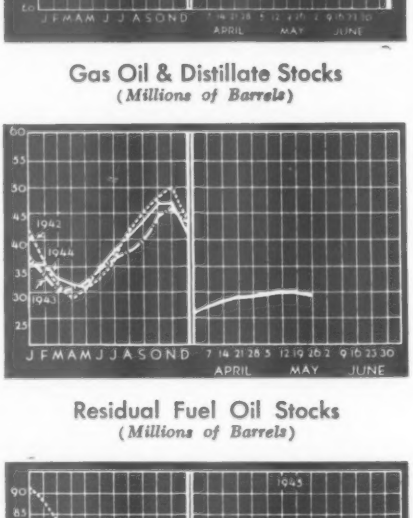
Gasoline Stocks

(Millions of Barrels)



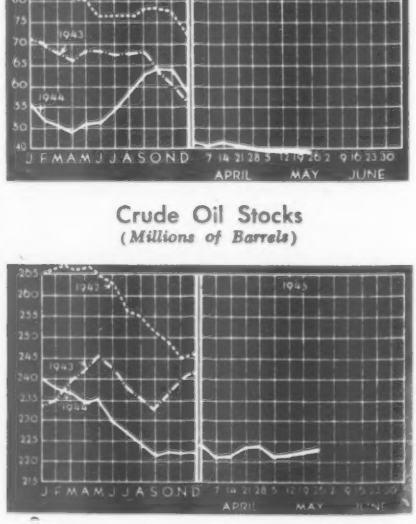
Gas Oil & Distillate Stocks

(Millions of Barrels)



Residual Fuel Oil Stocks

(Millions of Barrels)



Crude Oil Stocks

(Millions of Barrels)

OIL PRICE SECTION ★ At Refineries and Terminals and by Tank Wagon

Prices herewith are reproduced from Platt's *OILGRAM* Daily Oil Price Service, associated with National Petroleum News, whose representatives in all *NPN-OILGRAM* offices devote their time exclusively to reporting oil industry prices everywhere.

Prices shown are actual sales prices, or quotations meaning sellers' general offers or posted prices; for current sales and shipment; for the business day or period stated; except Tank Wagon prices, prices are for bulk lots such as tank car and motor transport; barge or tanker cargo lot prices are identified; FOB refineries or terminals; in cents per gal. except where shown in bbls. of 42 gals.; ex all fees and taxes; for crude oil and its products lawfully produced and transported; reported as received by *OILGRAM* and National Petroleum News but not guaranteed; for subscribers' private use only and not for resale or distribution or publication. For further details of price conditions apply to any *NPN-OILGRAM* office or see back of any *OILGRAM* Price Service invoice.

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Refinery Prices

Gasoline —U. S. Motor (A S T M) except where otherwise specified.

Prices in Effect	June 4	May 28
OKLAHOMA		
76 oct. Ethyl...	6.75	6.75
70-74 oct.....	5.875	5.875
63-66 oct.....	5.625 (1)	5.625 (1)
60 oct. & below.	5.25	5.25
MID-WESTERN (Group 3 basis)		
76 oct. Ethyl...	6.75	6.75
70-74 oct.....	5.875	5.875
63-66 oct.....	5.625 (2)	5.625 (2)
60 oct. & below.	5.2 – 5.25	5.2 – 5.25
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
76 oct. Ethyl...	7	7
70-74 oct.....	5.875	5.875
63-66 oct.....	5.625 (1)	5.625 (1)
60 oct. & below.	5.2 – 5.25	5.2 – 5.25
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
76 oct. Ethyl...	7 (2)	7 (2)
70-74 oct.....	5.875	5.875
63-66 oct.....	5.625 (1)	5.625 (1)
60 oct. & below.	5.25	5.25
CENT. W. TEX. (Prices to truck transports)		
76 oct.....	6.875–7 (2)	6.875–7 (2)
70-74 oct.....	5.875 (2)	5.875 (2)
67-69 oct.....	....	....
62 oct. & below.	5.25 (2)	5.25 (2)
KANSAS (For Kansas destinations only)		
76 oct. Ethyl...	7.2 – 7.3	7.2 – 7.3
70-74 oct.....	6.2	6.2
63-66 oct.....	5.9 (2)	5.9 (2)
60 oct. & below.	5.5	5.5
ARK. (For shipment to Ark. & La.)		
76 oct. Ethyl...	7 (1)	7 (1)
70-74 oct.....	5.875 (1)	5.875 (1)
62 oct. "	....	....
60 oct. & below, unleaded.....	5.25 (1)	5.25 (1)
WESTERN PENNA. (Motor gasoline)		
Bradford-Warren:		
"Q" Gasoline Min. 70 Oct. (ASTM)	7.625-8.225(a)	7.625-8.225(a)
Other districts:		
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.725	7.725

(a) Highs and lows for Schedule D area, in MPR 88 and outside Schedule D area, respectively.

Prices in Effect	June 4	May 28
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
U.S. Motor: (Oct. ASTM):		
70-74 oct.....	7.875– 8.375	7.875– 8.375
75-76 oct.....	9 (1)	9 (1)
Str. run gasoline, excluding Detroit shpt.....	6	6
OHIO (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances).		
70-74 oct.....	8.25	8.25
CALIFORNIA U.S. Motor:		
76 oct. (Ethyl)...	8 – 8.75	8 – 8.75
70-74 oct.....	7 – 7.5	7 – 7.5
65 oct. & below (3rd grade).....	5.75 – 6.25	5.75 – 6.25

Kerosine, & Gas Fuel Oils

Prices in Effect	June 4	May 28
OKLAHOMA		
41-43 grav. w.w...	4.375	4.375
42-44 grav. w.w...	4.5	4.5
Range oil.....	4	4
No. 1 p.w.....	3.875	3.875
No. 1 straw.....	....	....
No. 2 straw.....	3.625	3.625
No. 3 fuel.....	3.5	3.5
No. 6 fuel.....	$0.90–$0.97	$0.90–$0.97
U. G. I. Gas Oil..	....	....
14-16 fuel.....	$0.97 (1)	$0.97 (1)
MID-WESTERN (Group 3 basis)		
41-43 grav. w.w...	4.375	4.375
42-44 grav. w.w...	4.5	4.5
Range Oil.....	4 –4.1 (2)	4 –4.1 (2)
No. 1 p.w.....	3.875	3.875
No. 2 straw.....	3.625	3.625
No. 3.....	....	....
No. 5.....	....	....
No. 6.....	$0.97 (1)	$0.97 (1)
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
41-43 grav. w.w...	4.375	4.375
42-44 grav. w.w...	4.5 (1)	4.5 (1)
No. 1 p.w.....	3.875 (1)	3.875 (1)
No. 6 fuel.....	$0.97 (1)	$0.97 (1)
W. TEX. No 6 fuel.....	$0.97 (1)	$0.97 (1)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
42-44 grav. w.w...	4.5 (1)	4.5 (1)
KANSAS (For Kansas destinations only).		
41-43 grav. w.w...	No Price	No Price
42-44 grav. w.w...	4.7	4.7
No. 1 p.w.....	4.1	4.1
No. 6 fuel.....	$0.95–$1.02	$0.95–$1.02
ARK. (For shipment to Ark. and La.)		
41-43 grav. w.w...	....	....
42-44 w.w. kero...	4.5 (1)	4.5 (1)
No. 1.....	....	....
No. 2.....	3.625 (1)	3.625 (1)
No. 3 fuel.....	3.5 (1)	3.5 (1)
Tractor fuel, for shpt. to Ark. points only....	5.125 (1)	5.125 (1)
Diesel fuel 52 & below.....	4 (1)	4 (1)
Diesel fuel 58 & above.....	4.25 (1)	4.25 (1)
WESTERN PENNA. *Bradford-Warren:*		
45 grav. w.w.....	6.5 – 7.55	6.5 – 7.55
46 grav. w.w.....	....	....
No. 1 fuel.....	6.75(1&b)	6.75(1&b)
No. 2 " ...	6.125-7.125(2&b)	6.125-7.125(2&b)
No. 3 "	6.25-7.25(1&b)	6.25-7.25(1&b)
36-40 gravity.....	6.625-6.75(2)	6.625-6.75(2)

(b) Highs and lows for Schedule D area, in MPR 88 and outside Schedule D area, respectively.

Other districts:		
45 grav. w.w.....	7 – 7.425	7 – 7.425
46 grav. w.w.....	7.125– 7.375	7.125– 7.375
47 grav. w.w.....	7.375– 7.50	7.375– 7.50
No. 1 fuel.....	6.875– 7.175	6.875– 7.175
No. 2 "	6.75 – 6.875	6.75 – 6.875
No. 3 "	6.75	6.75
36-40 grav. Pittsburgh dist. prices excluded.....	6.625– 6.875	6.625– 6.875
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
46-49 gravity w.w.	5.8 – 6	5.8 – 6
P.W. Distillate...	5.5	5.5
No. 3 gas, oil, Straw	5	5
U.G.I. gas oil.....	4.5 (2)	4.5 (2)
Fuel Oils (*Vis. at* 100).		
300-500 Vis.....	4.14 (2)	4.14 (2)
100-300 Vis.....	4.5	4.5
OHIO (S. O. quotations for statewide delivery)		
Kerosine.....	7	7

Prices in Effect	June 4	May 28
CALIFORNIA		
40-43 grav. w.w...	5 – 7	5 – 7
San Joaquin Valley:		
Heavy fuel.....	$1.10 (2)	$1.10 (2)
Light fuel.....	$1.20 (2)	$1.20 (2)
Diesel fuel.....	4 (2)	4 (2)
Stove dist.....	5 (2)	5 (2)
Los Angeles:		
Heavy fuel.....	$1.10 (2)	$1.10 (2)
Light fuel.....	$1.20 (2)	$1.20 (2)
Diesel fuel.....	4 (2)	4 (2)
Stove dist.....	5 (1)	5 (1)
San Francisco:		
Heavy fuel.....	$1.15 (1)	$1.15 (1)
Light fuel.....	$1.25 (1)	$1.25 (1)
Diesel fuel.....	4.5 (1)	4.5 (1)
Stove dist.....	5.5 (1)	5.5 (1)

NOTE: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

Lubricating Oils

Prices in Effect	June 4	May 28
WESTERN PENNA. Prices are for sales made, or offers reliably reported, to jobbers & compounders only. Viscous Neutrals— *No. 3 col Vis. at* 70°*F.*		
200 Vis. (180 at 100°) 420-425 fl.		
0 p.t.....	38 (1)	38 (1)
10 p.t.....	37 (1)	37 (1)
15 p.t.....	36 (1)	36 (1)
25 p.t.....	28–33	28–33
150 Vis. (143 at 100°) 400-405 fl.		
0 p.t.....	36 (1)	36 (1)
10 p.t.....	35 (1)	35 (1)
15 p.t.....	34 (1)	34 (1)
25 p.t.....	26–31	26–31

NOTE: Limited quantity neutrals available to regular trade.

Cylinder Stocks:		
Brt. stk., 145-155 *vis. at* 210°, 540-550 fl., *No. 3 col.*		
10 p.t.....	30.5 (1)	30.5 (1)
15 p.t.....	29.5 (1)	29.5 (1)
25 p.t.....	25	25
600 S.R. filterable	15	15
650 S.R.....	15.5	15.5
600 fl.....	16	16
630 fl.....	17	17

MID-CONTINENT (F. o. b. Tulsa)		
Neutral Oils (*Vis. at* 100° *F. to* 10 *P.P.*)		
Pale Oils:		
Vis. Color		
60-85—No. 2....	7.5	7.5
86-110—No. 2...	7.5 – 8.5	7.5 – 8.5
150—No. 3.....	11 –11.5	11 –11.5
180—No. 3.....	11.5 –16	11.5 –15
200—No. 3.....	12 –15	12 –15
250—No. 3.....	14 –16.5	14 –16.5
280—No. 3.....	15 –17	15 –17
300—No. 3.....	16 –18	16 –18
Red Oils:		
180—No. 5.....	11.5 (1)	11.5 (1)
200—No. 5.....	12 (1)	12 (1)
280—No. 5.....	No Price	No Price
300—No. 5.....	16–17.5 (2)	16–17.5 (2)
Bright Stock—*Vis. at* 210°		
200 Vis. D.....	27 (1)	27 (1)
150-160 Vis. D: 0 to 10 p.p.....	23	23
10 to 25 p.p.....	22.5–23	22.5–23
25 to 40 p.p.....	23 (1)	23 (1)
150-160 Vis. E.....	22 (1)	22 (1)
120 Vis. D: 0 to 10 p.p.....	22 (2)	22 (2)
600 S.R. Dark Green.....	8.5 (1)	8.5 (1)
600 S.R. Olive Green.....	10-11 (2)	10-11 (2)
631 S.R.....	....	....
Black Oil.....	....	....

NOTE: Discounts of 0.5c to 1c on bright stock and 0.5c to 2c allowed for neutrals, 10 car lots, and to "meet competition." Brokers offering at greater discounts.

SOUTH TEXAS (Neutral Oils)		
Pale Oils (*Vis. at* 100°*F.*)		
Vis. Color		
100 No. 1½-2½.	6.5	6.5
200 No. 2-3.....	8.75	8.75
300 No. 2-3.....	9.25	9.25
500 No. 2½-3½.	10	10
750 No. 3-4.....	10.25	10.25
1200 No. 3-4.....	10.375	10.375
2000 No. 4.....	10.5	10.5

(Continued on next page)

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown; bids reported in market leads.

Refinery Prices (Continued)

Prices in Effect	June 4	May 28
Red Oils:		
100 No. 5-6	6.5 (2)	6.5 (2)
200 No. 5-6	8.75	8.75
300 No. 5-6	9.25	9.25
500 No. 5-6	10	10
750 No. 5-6	10.25	10.25
1200 No. 5-6	10.375	10.375
2000 No. 5-6	10.5	10.5

CHICAGO (From Mid-Continent p.l. crude.) Neutral oils *vis. at* 100° *F. to* 10 *p.p.*

Pale Oils Vis. Color		
60-85—No. 2	9 (1)	9 (1)
86-110—No. 2	9.25 (1)	9.25 (1)
150—No. 3	12.5 (1)	12.5 (1)
180—No. 3	13 (1)	13 (1)
200—No. 3	13 (1)	13 (1)
250—No. 3	14 (1)	14 (1)
Red Oils:		
180—No. 5	13 (1)	13 (1)
200—No. 5	13 (1)	13 (1)
250—No. 5	14 (1)	14 (1)
280—No. 5	15 (1)	15 (1)
300—No. 5	15.5 (1)	15.5 (1)

Note: Viscous oils, 15 to 30 p.p. are quoted 0.5c lower; 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

Unfiltered Steam Refined (*Viscosity at* 210°)

140	11.5 (1)	11.5 (1)
160	12.5 (1)	12.5 (1)
200	13.5 (1)	13.5 (1)

Bright stocks, 160 *vis. at* 210 *No.* 8 *color:*

0 to 10 p.p.	24 (1)	24 (1)
15 to 25 p.p.	23.5 (1)	23.5 (1)
30 to 40 p.p.	21.5 (1)	21.5 (1)
E filtered Cyl. Stock	15.5 (1)	15.5 (1)

Note: To obtain prices delivered in Chicago add 0.25c per gal.

Natural Gasoline

(Group 3 & Breckenridge prices are to blenders on freight basis shown below. Shipments may originate in any Mid-Continent manufacturing district.)

FOB GROUP 3

Grade 26-70..... 4.5 (Sales) 4.5 (Quotes)

FOB BRECKENRIDGE

Grade 26-70.....4.125 (Qts) 4.125-4.375(Qts)

CALIFORNIA (FOB plants in Los Angeles basin)

21 pound vapor pressure for blending.... 4.75 - 5.375 4.75 - 5.375

Naphtha and Solvent

(*FOB Group* 3)

Stoddard solvent	6.625	6.625
Cleaners' naphtha	7.125	7.125
V.M.&P. naphtha	7.1 - 7.125	7.1 - 7.125
Mineral spirits	6.1 - 6.125	6.1 - 6.125
Rubber solvent	7.1 - 7.125	7.1 - 7.125
Lacquer diluent	7.375- 8.125	7.375- 8.125
Benzol Diluent	7.875-8.625(a)	7.875- 8.625

(*a*) *Typographical error.*

WESTERN PENNA.

Other Districts:

Untreated naphtha	7 -7.25 (2)	7 -7.25 (2)
Stoddard solvent	7.25 -7.5	7.25 -7.5

OHIO (S. O. quotations for statewide delivery:)

V.M.&P. naphtha.	D.C. naphtha,	Varnolene &
Sohio solvent	10	10
Rubber solvent	9	9

Wax

WESTERN PENNA. (Bbls. C.L.)
White Crude Scale:

122-124 A.m.p.	4.25 (2)	4.25 (2)
124-126 A.m.p.	4.25	4 25

OKLAHOMA (C.L. FOB Refinery)

Semi-refined:

128 AMP min., white, 50 kilo bags	No Price	No Price
132-134 AMP, bbls.	5.25 (1)	5.25 (1)

CHICAGO (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose, 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

Fully refined:

122-124 (bags only)	5.6	5.6
125-127	6	6
127-129	6.25	6.25
130-132	6.55	6.55
132-134	6.8	6.8
135-137	7.55	7.55

Petrolatums

WESTERN PENNA. (Bbls., carloads; tank cars, 0.5c per lb. less.)

Snow White	6.125- 7.25	6.125- 7.25
Lily White	5.375- 6.25	5.375- 6.25
Cream White	4.375- 5.5	4.375- 5.5
Light Amber	3.375- 4	3.375- 4
Amber	3.125- 3.75	3.125- 3.75
Red	3 - 3.5	3 - 3.5

Tank Wagon Prices

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include taxes;** *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect June 4, 1945 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

S. O. N. J.

Esso (*Regular Grade*)	Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
*Atlantic City, N. J.	10.2	10.7	4.5	10.00
*Newark	10.2	10.7	4.5	10.00
Annapolis, Md.	10.55	11.05	5.5	.....
Baltimore	9.95	10.45	5.5	10.8
Cumberland	11.35	11.85	5.5	12.3
Washington, D. C.	10.20	10.7	4.5	11.3
Danville, Va	11.65	12.15	6.5	11.55
Petersburg	10.75	11.25	6.5	12.3
Norfolk	10.45	10.95	6.5	11.3
Richmond	10.75	11.25	6.5	12.3
Roanoke	11.95	12.45	6.5	11.8
Charleston, W. Va	11.65	12.15	6.5	13.1
Parkersburg	10.95	11.45	6.5	12.8
Wheeling	10.95	11.45	6.5	13.4
Charlotte, N. C.	11.7	12.20	7.5	11.3
Hickory	12.25	12.75	7.5	12.3
Mt. Airy	12.1	12.6	7.5	11.5
Raleigh	11.45	11.95	7.5	12.3
Salisbury	11.75	12.25	7.5	12.7
Charleston, S. C.	10.55	11.05	7.5	.....
Columbia	11.4	11.9	7.5	.....
Spartanburg	12.1	12.6	7.5	.....
New Orleans, La.	8.75	9.25	8.5	**8.00
Baton Rouge	8.75	9.25	8.5	**8.5
Alexandria	8.75	9.25	8.5	**8.5
Lake Charles	9.00	9.5	8.5	**10.00
Shreveport	8.5	9.00	8.5	**7.00
Knoxville, Tenn.	10.5	11.00	8.5	10.5
Memphis	8.9	9.4	8.5	8.5
Chattanooga	10.5	11.00	8.5	9.00
Nashville	10.5	11.00	8.5	8.00
Bristol	10.95	11.45	8.5	11.1
Little Rock, Ark.	9.5	10.00	8.0	10.00

	Mineral Spirits T.W.	V.M.&P. T.W.
Newark, N. J.	13	14.5
Baltimore, Md.	15.5	....
Washington, D. C.	15.5	....

Fuel Oils—T.W.	No. 1	No. 2	No. 3
Atlantic City, N. J.	10	9	9
Newark	10	9	9
Annapolis, Md.	..	..	..
Baltimore	9.8	9	9
Washington, D. C.	10.3	9.4	9.4
Norfolk, Va.	10	8.8	8.8
Petersburg	10.3	9	..
Richmond	10.3	9	9
Charlotte, N. C.	10.3	10.1	..
Hickory, N. C.	..	9.7	..
Raleigh	11.3	9.8	..
Charleston, S. C.	..	8.7	..
Columbia	..	9.7	..
Spartanburg	..	10.5	..

*Effective Aug. 5, '42 minimum retail resale price of 14.2c posted thru New Jersey.
Discounts:
**Includes 1.0c per gallon State Tax.
*Effective Nov. 7, 1944, the discount for kerosine in the State of Virginia was eliminated, the discount in Tennessee was eliminated May 1, 1945 and the discount in Louisiana was eliminated May 7, 1945.

Undivided Dealers at Dealer Tank Wagon price less 0.5c per gallon for Esso Gasoline.

Esso gasoline—to undivided dealers, 0.5c off dealer t.w.

Kerosine—1c off t.w. price for 25 gals. or more, under contract thru territory (Baltimore city contract not necessary) except no discount in state of New Jersey, Virginia, Tennessee and Louisiana.

Naphtha—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals. 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

Notice

These prices include inspection fees on both gasoline and kerosine unless otherwise specified per gallon as follows:

Ala. 1/40c on gasoline; Ark. 1/20c; Fl. 1/8c; Ill. 3/100c; Ind. 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 25 bbls.; Kans. 1/50c; La. 1/32c; Minn. 7/200c; Miss. 1/50c; Neb. 3/100c; Nev. 1/20c; N. C. 1/4c; N. Da. 1/20c; Okla. 2/25c; S. Car. 1/8c; S. Da. 1/20c; Tenn. 2/5c; and Wisc. 3/100c.

Kerosine inspection fees only: Ala. 1/2c; Fla. 1/8c; Iowa 3/50c; Mich. 1/5c per gal.

CONT'L OIL

	Conoco Bronz-z-z †Tank	Demand (*3rd Grade*) Wagon	Gasoline Taxes	Kerosine T.W.
Denver, Col.	10	9	5.5	10
Grand Junc., Col.	12.5	11.5	5.5	12.5
Pueblo, Col.	9.5	8.5	5.5	9.5
Casper, Wyo.	11.5	10.5	5.5	12
Cheyenne, Wyo.	10	9	5.5	9
Billings, Mont.	12	11	6.5	12.5
Butte, Mont.	11.5	10.5	6.5	13.5
Great Falls, Mont.	12	11	6.5	12.5
Helena, Mont.	12	11	6.5	13
Salt Lake City, Utah	13.5	12.5	5.5	14.5
Twin Falls, Ida.	14.5	13.5	7.5	17
Albuquerque, N. M.	10.5	9.5	*7	9.5
Roswell, N. M.	10	9	*7	7
Santa Fe, N. M.	10.5	9.5	*7.5	10
Ft. Smith, Ark.	9	6.25	8	8
Texarkana, Ark.	9	7.5	*5.5	7
Muskogee, Okla.	7.75	6.75	9	8
Oklahoma City, Okla.	8	7	9	8
Tulsa, Okla.	8	7	9	8

*Taxes: In gasoline tax column are included these city taxes—Albuquerque, & Roswell, 0.5c, Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.

†To consumers & Dealers.

NOTE: Current selling price—where this is lower than maximum price it is because of local competition. It is the actual selling price and is subject to revision due to delays in receiving information from the field

Arkansas tax 8c applies at Ft. Smith.

S. O. CAL.

	Standard Posted Net Tank Truck	Standard Posted Retail	Flight Posted Net Tank Truck	Flight Posted Retail	Gasoline Taxes
	Standard Gasoline (*Regular Grade*)		Flight Gasoline (*Third Grade*)		
San Francisco, Cal.	10	14	9	12	4.5
Los Angeles, Cal.	9.5	13.5	8.5	11.5	4.5
Fresno, Cal.	11	15	10	13	4.5
Phoenix, Ariz.	12	16	10	13	6.5
Reno, Nev.	12	16	11	14	5.5
Portland, Ore.	10.5	14.5	9.5	12.5	6.5
Seattle, Wash.	10.5	14.5	9.5	12.5	6.5
Spokane, Wash.	12.5	16.5	11.5	14.5	6.5
Tacoma, Wash.	10.5	14.5	9.5	12.5	6.5

*Chevron Aviation 73

	Posted Net Tank Truck	Gasoline Taxes	Kerosine Tank Truck
San Francisco, Cal.	12.5	4.5	11.5
Los Angeles, Cal.	12	4.5	10
Fresno, Cal.	13.5	4.5	12.5
Phoenix, Ariz.	14.5	6.5	12.5
Reno, Nev.	14.5	5.5	13.5
Portland, Ore.	13	6.5	13.8
Seattle, Wash.	13	6.5	13.8
Spokane, Wash.	16	6.5	16.8
Tacoma, Wash.	13	6.5	13.8

Resale and Commercial Gasoline: Tank car deliveries of Chevron Aviation 73, Standard's Supreme and Flight Gasoline .25c per gal. below posted net tank truck price. Tank car deliveries of Standard Gasoline .375c per gal. below posted net tank truck price. Pearl Oil (The Standard Kerosene) Tank car deliveries 3c below posted tank truck price.

*Formerly Standard Aviation 73.

TEXAS CO.

	Gasoline—Dealer T.W. Fire-Chief (Regular)	Indian (*3rd Grade*)	Gasoline Taxes
Dallas, Tex.	7.5	6.5	5.5
Ft. Worth, Tex.	7.5	6.5	5.5
Wichita Falls, Tex.	8.5	7.5	5.5
Amarillo, Tex.	8.5	7.5	5.5
Tyler, Tex.	8.5	7.5	5.5
El Paso, Tex.	11	10.5	5.5
San Angelo, Tex.	8.5	7.5	5.5
Waco, Tex.	8.5*	7*	5.5
Austin, Tex.	8.5	7.5	5.5
Houston, Tex.	8.5	7.5	5.5
San Antonio, Tex.	8.5	7.5	5.5
Port Arthur, Tex.	8.5	7.5	5.5

*Less 1c temporary allowance to all dealers.

(Continued on next page)

Tank Wagon Prices—Continued

S. O. IND.

	Red Crown Blue Crown Red Dealer Crown Cons. T.W.	Red Crown T.W.	Blue Crown T.W.	(*Regular Grade*) (*Third Grade*) Prices Gasoline Taxes	Kerosine T.W.
Chicago, Ill.	11.6	9.6	9.1	4.5	10.6
Decatur, Ill.	11.6	9.6	8.7	4.5	10.3
Joliet, Ill.	11.9	10.3	9.2	4.5	10.6
Peoria, Ill.	11.7	9.9	9.7	4.5	10.4
Indianapolis, Ind.	11.6	10.1	9.6	5.5	10.1
Evansville, Ind.	11.4	9.9	8.6	5.5	9.9
South Bend, Ind.	12	10.5	10	5.5	10.5
Detroit, Mich.	11.4	9.9	...	4.5	10
Grand Rapids, Mich.	11.4	9.9	...	4.5	9.9
Saginaw, Mich.	11.4	9.9	...	4.5	9.9
Green Bay, Wis.	12.2	10.7	10.2	5.5	10.9
Milwaukee, Wis.	12.1	10.6	10.1	5.5	10.8
La Crosse, Wis.	11.9	10.4	9.9	5.5	10.6
Minneapolis - St. Paul.	11.9	10.4	9.9	5.5	10.6
Duluth, Minn.	12.2	10.7	10.2	5.5	10.9
Mankato, Minn.	11.9	10.4	9.9	5.5	10.6
Des Moines, Ia.	11.4	9.9	9.4	4.5	*10.1
Mason City, Ia.	11.7	10.2	9.7	4.5	*10.4
St. Louis, Mo.	11.0	9.5	9.3	*4.5	10.1
Kansas City, Mo.	11.0	9.5	8.6	*4.5	9.7
St. Joseph, Mo.	11.2	9.7	9.2	*4.5	9.9
Fargo, N. D.	12.9	11.4	10.9	5.5	11.6
Huron, S. D.	12.3	10.8	10.3	5.5	11
Wichita, Kans.	10.3	8.8	7.2	4.5	9.0
Omaha, Neb.	11.4	9.6	9.4	6.5	10.1

	Oleum Spirits	V.M.&P. Naphtha	Stanisol	*Taxes
(Prices are base prices before discounts)				
Chicago	13.5	13.8	12.8	4.5
Detroit	15.8	15	16.3	4.5
K. C., Mo.	13.3	14.3	13.8	1.5
St. Louis, Mo.	13.7	14.7	13.2	1.5
Milwaukee	14.4	15.4	14.9	5.5
Minneap'ls	14.2	15.2	13.5	5.5

Fuel Oils T.W. Chicago	Standard Heater Oil	Stanolex Furnace Oil
1-99 gals.	9.3	8.8
100-149 gals.	8.3	7.8
150 gals. & over	7.8	...
150-399 gals.	...	7.8
400 gals. & over	...	7.3

	Stanolex Fuel A	Stanolex Fuel C
1-749 gals.	6.5	6.0
750 gals. & over	5.75	5.25

Stanolex Furnace Oil

Other Points	1-99 gals.	100 gals. & over
Indianapolis	9.0	8.0
Detroit	8.7	7.7
Milwaukee	9.0	8.0
Minneapolis	9.1	8.1
St. Louis	8.4	7.4
Kansas City	8.1	7.1

*Taxes: In gasoline tax column are included these city taxes—Kansas City, St. Joseph and St. Louis, 1c. Iowa kerosine prices are ex 3c state tax. In naphtha tax column are included 1.5c federal tax and state taxes.

State sales, occupation, consumer and use taxes to be added when applicable.

S. O. OHIO

	*Sohio X-70 Gasoline (*Regular Grade*) Consumer T.W.	**Retailers	‡S.S.	Gasoline Taxes	†Kerosine T.W.
Ohio, Statewide	12	10	13.5	5.5	9.3
Akron	12	9.5	12.5	5.5	9.3
Canton	12	9.5	12.5	5.5	9.3
Cincinnati	12	9.5	12.5	5.5	9.3
Cleveland	12	9.5	12.5	5.5	9.3
Columbus	12	9.5	12.5	5.5	9.3
Dayton	12	9.5	12.5	5.5	9.3
Lima	12	9.5	12.5	5.5	9.3
Mansfield	12	9.5	12.5	5.5	9.3
Marion	12	9.0	12.0	5.5	9.3
Portsmouth	12	9.5	12.5	5.5	9.3
Toledo	12	9.5	12.5	5.5	9.3
Youngstown	12	9.5	12.5	5.5	9.3
Zanesville	12	9.5	12.5	5.5	9.3

Aviation Gasoline—Statewide

	Consumer Gasoline T.W.	Taxes
Sohio Aviation Gasoline clear	14.5	5.5
Spec. AN-F-22	14.5	5.5
Esso Ethyl Aviation 73 Oct.	15.5	5.5
Esso Ethyl Aviation 80 Oct.	16.5	5.5
Esso Ethyl Aviation 91 Oct.	17.5	5.5
Esso Ethyl Aviation 100 Oct.	24.5	5.5

	Naphtha—T.W. Statewide	Lucas County
S. R. Solvent	13.5	13.5
D. C. Naphtha	14.5	14.25
V.M.&P. Naphtha	14.5	14.25
Varnolene	14.5	14.25
Sohio Solvent	14.5	14.25

Fuel Oils—T.W.	No. 1	No. 2	No. 3	No. 4
Ohio, Statewide	8.3	8.3	7.8	*7.55

*Renown (third-grade) prices are same as X-70 unless otherwise noted.

**Except authorized agents.

‡Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

*For Cleveland area only. Full compartment hose dumps.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals. are 0.5c higher.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals., 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price, 50 to 249 gals., 0.5c; 250 to 499 gals., 1c; 500 gals. or over, 1.5c.

ATLANTIC REFINING

Atlantic White Flash (*Regular Grade*)

	Commercial T.W.	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
Philadelphia, Pa.	10.2	10.7	5.5	12.25
Pittsburgh	10.1	10.6	5.5	12.1
Allentown	10.7	11.2	5.5	12.6
Erie	10.1	10.6	5.5	12.1
Scranton	10.7	11.2	5.5	12.6
Altoona	10.7	11.2	5.5	12.6
Emporium	10.1	10.6	5.5	12.1
Indiana	10.7	11.2	5.5	12.6
Uniontown	10.1	10.6	5.5	12.1
Harrisburg	10.7	11.2	5.5	12.6
Williamsport	10.7	11.2	5.5	12.6
Dover, Del.	....	11.2	5.5	12.6
Wilmington, Del.	....	10.7	5.5	12.1
Boston, Mass.	....	10.9	4.5	....
Springfield, Mass.	....	11.8	4.5	....
Worcester, Mass.	....	11.5	4.5	....
Fall River, Mass.	....	11	4.5	....
Hartford, Conn.	....	11.6	4.5	....
New Haven, Conn.	....	11	4.5	....
Providence, R. I.	....	11	4.5	....
Atlantic City, N. J.	....	10.7	4.5	10
Camden, N. J.	....	10.7	4.5	10
Trenton, N. J.	....	10.7	4.5	10
Annapolis, Md.	....	11.05	5.5	10.8
Baltimore, Md.	....	10.45	5.5	9.8
Hagerstown, Md.	....	11.55	5.5	10.3
Richmond, Va.	....	11.25	6.5	12.3
Wilmington, N. C.	....	11.15	7.5	11.6
Brunswick, Ga.	....	10.1	7.5	10.6
Jacksonville, Fla.	....	10.1	8.5	11.6

	Mineral Spirits T.W.†	V.M.&P. T.W.†
Philadelphia, Pa	11	12.5
Lancaster, Pa	12	13.5
Pittsburgh, Pa	12.5	13.5

Fuel Oils—T.W.	1	2	3	5	6
Phila., Pa.	10.1	9	9	5.76	5.04
Allentown, Pa.	10.6	9.3	9.3	....	....
Wilmington, Del.	10.1	9	9	....	....
Springfield, Mass.	....	9.4	9.4	....	....
Worcester, Mass.	....	9.3	9.3	....	....
Hartford, Conn.	....	9.2	9.2	....	....

‡Does not include 1c Georgia kerosine tax.

†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.

Discounts:

Gasoline—to undivided dealers, 0.5c off dealer t.w. except Georgia & Florida dealer t.w. and undivided dealer t.w. prices are same.

Kerosine—Thru Penna. & Delaware, 2c off t.w. price on t.w. deliveries of 25 gals. or more at one time.

S. O. KY.

Crown Gasoline (*Regular*) Standard (*Third Grade*)

	†Net Crown	Gasoline Taxes	Kerosine T.W.
Covington, Ky.	9.5	6.5	9.3
Lexington, Ky.	10.5	6.5	9.3
Louisville, Ky.	10	6.5	8.8
Paducah, Ky.	10	6.5	8.8
Jackson, Miss.	10	7.5	*9
Vicksburg, Miss.	9.5	7.5	*8.5
Birmingham, Ala.	10	*8.5	9
Mobile, Ala.	9	*9.5	8.5
Montgomery, Ala.	10	*9.5	*10
Atlanta, Ga.	11.1	7.5	*11.6
Augusta, Ga.	11.1	7.5	*11.1
Macon, Ga.	11.1	7.5	*11.6
Savannah, Ga.	10.1	7.5	*10.6
Jacksonville, Fla.	10.1	8.5	9.6
Miami, Fla.	10.1	8.5	9.6
Pensacola, Fla.	9	*9.5	8
Tampa, Fla.	10.1	8.5	9.6

*Taxes: In tax column are included these city and county gasoline taxes: Mobile, 2c city; Birmingham, 1c city, Montgomery, 1c city and 1c county; Pensacola, 1c city. Georgia and Montgomery, Ala. have 1c kerosine tax, Mississippi 0.5c, included in above prices.

†Consumer t.w. prices are same as net dealer prices.

HUMBLE OIL

Humble Motor Fuel (*Regular Grade*)

	Thriftane Humble *Tank Wagon	Regular tail	(*Third Grade*) Thriftane *Tank Wagon	Regular tail	Gasoline Taxes
Dallas, Tex.	7.5	10.5	6.5	8.5	5.5
Ft. Worth, Tex.	7.5	10.5	6.5	8.5	5.5
Houston, Tex.	8.5	12.5	7.5	10.5	5.5
San Ant., Tex.	8.5	12.5	7.5	10.5	5.5

Consumer tank wagon prices are 1c per gal. above the dealer tank wagon prices at Dallas and Ft. Worth.

	Kerosine *Tank Wagon	Retail
Dallas, Tex.	7	10
Ft. Worth, Tex.	7	11
Houston, Tex.	8	11
San Antonio, Tex.	7	10

*To all classes of dealers & consumers.

Canada

PRICES OF IMPERIAL OIL, LTD.

Per Imperial Gallon, which is 1.2 U. S. Gallons

IMPERIAL OIL

	3-Star Imperial Gasoline (*Regular Grade*) †Gasoline T.W.	*Gasoline Taxes	Kerosine T.W.
Hamilton, Ont.	16.5	11	18
Toronto, Ont.	16.5	11	18
Brandon, Man.	20.5	10	22.5
Winnipeg, Man.	20.0	10	22
Regina, Sask.	17.5	10	19.5
Saskatoon, Sask.	20.3	10	22.3
Edmonton, Alta.	18.4	10	20.4
Calgary, Alta.	15.5	10	17.5
Vancouver, B. C.	15	10	24
Montreal, Que.	16.5	11	17.5
St. John, N. B.	16	13	19
Halifax, N. S.	16	13	19

*Includes 3c Federal, and Provincia taxes.

†To divided & undivided dealers.

Above prices are those in effect May 17, 1945.

SOCONY VACUUM

	Socony Mobilgas (*Regular Grade*) Com. Cons. T.W.	Undiv. Dlr. T.W.	Gasoline Taxes
New York City			
Manhattan & Bronx	10.1	10.6	*5.5
Kings & Queens	10.1	10.6	*5.5
Richmond	9.7	10.2	*5.5
Albany, N. Y.	9.9	10.4	5.5
Binghamton, N. Y.	11	11.5	5.5
Buffalo	9.6	10.1	5.5
Jamestown, N. Y.	9.8	10.3	5.5
Mt. Vernon, N. Y.	10.1	10.6	5.5
Plattsburg, N. Y.	11	11.5	5.5
Rochester, N. Y.	10.8	11.3	5.5
Syracuse, N. Y.	10.5	11	5.5
Bridgeport, Conn.	10	10.5	4.5
Danbury, Conn.	10.5	11	4.5
Hartford, Conn.	10.6	11.1	4.5
New Haven, Conn.	10	10.5	4.5
Bangor, Me.	10.7	11.2	5.5
Portland, Me.	10.3	10.8	5.5
Boston, Mass.	9.9	10.4	4.5
Concord, N. H.	11.4	11.9	5.5
Lancaster, N. H.	12	12.5	5.5
Manchester, N. H.	11.3	11.8	5.5
Providence, R. I.	10	10.5	4.5
Burlington, Vt.	10.9	11.4	5.5
Rutland, Vt.	11	11.5	5.5

(Continued on next page)

Seaboard Export Coastwise Prices

Atlantic Coast

(Prices are of refiners, FOB their refineries & their tanker terminals, & of tanker terminal operators FOB their terminals)—Prices in Effect June 4.

MOTOR GASOLINE

District	72 Oct. (ASTM)	70-74 oct. (ASTM)	KEROSINE and /or NO. 1 FUEL
N. Y. Harb.	Not made	9.075	7.1
N. Y. Harb., barges	"	8.5 – 8.975	7
Albany	"	9.175	7.3
Philadelphia	"	9.075	7.2
Baltimore	"	8.825	7.2
Norfolk	"	8.575	7.1
Wilmington, N. C.	"	8.175	6.75
Charleston	"	8.175	6.9
Savannah	"	7.845	6.55
Jacksonville	"	7.845	6.55
Miami	"	7.845	6.55
Tampa	"	7.845	6.55
Pensacola	"	6.875 (1)	4.8 (1)
Mobile	"	6.62 – 6.745	4.75 (2)
New Orleans	"	6.125 (1)	4.125–4.25
Portland	"	9.375	7.3
Boston	"	9.275	7.2
Providence	"	9.275	7.2

FUEL OILS

No. 2	No. 3	No. 5	No. 6
6.7	6.7	$1.85–$1.95(a)	$1.77
6.6	6.6 (2)	....	....
6.8	6.8	....	$1.97 (1)
6.7	6.7	$1.98	$1.77
6.7	6.7	$1.85 (1)	$1.77
6.7	6.7 (1)	$1.85 (1)	$1.77
6.4	....	....	....
6.4 (2)	....	$1.80 (1)	$1.72 (2)
5.75 (1)	....	....	$1.72 (1)
5.75	....	....	$1.72 (2)
5.75 (1)	....	....	....
5.75	....	....	$1.62
....	....	....	....
....	....	....	....
3.75 (2)	....	$1.05(1)	$0.97
6.8	6.8 (2)	....	$1.77
6.7	6.7 (2)	$1.95 (2)	$1.77
6.7	6.7 (2)	$1.90 (1)	$1.77

Tank Wagon Prices (Continued)

	Mineral Spirits T.W.	V.M.&P. T.W.
Buffalo, N. Y.	12.4	13.6
New York City	11	12
Rochester, N. Y.	13.2	14.4
Syracuse, N. Y.	14	....
Boston, Mass.	12	13
Bridgeport, Conn.	†16.3	†17.3
Hartford, Conn.	†16.3	†17.3
Providence, R. I.	13	14

	Kerosine Yard	Kerosine T.W.	Mobilfuel Diesel T.C.	Mobilfuel Diesel T.W.	Mobilheat Fuel Yard	Mobilheat Fuel T.W.
New York:						
Manhat'n & Bronx	7.5	10.3	...	9.3	7.1	9
Kings & Queens	7.5	10.3	...	9.3	7.1	9
Richmond	7.5	10.3	...	...	7.1	9.0
Albany	7.5	9.8	6.8	9.3	7	9
Binghamton	8.9	11.2	...	10.7	8.4	10.2
Buffalo	8.1	10.4	7.5	9.8	7.7	9.5
Jamestown	8.2	10.5	...	10.1	7.8	9.5
Mt. Vernon	7.6	10.3	...	9.4	7.2	9
Plattsburg	8.1	10.4	...	9.9	7.6	9.4
Rochester	8.7	11	7.9	10.2	7.9	9.7
Syracuse	8.5	10.8	7.8	10.1	7.8	9.6
Conn.:						
Bridgeport	7.8	10.3	...	....	7.3	9.0
Danbury	8.2	10.8	...	....	7.8	8.5
Hartford	8.0	10.5	...	9.5	7.4	9.2
New Haven	7.5	10.3	...	9.3	7.1	9.0
Maine:						
Bangor	7.9	10.3	7.4	9.7	7.4	9.1
Portland	7.5	10.2	6.8	9.3	7	9
Mass.:						
Boston	7.8	10.6	6.7	9.2	7.1	9
N. H.:						
Concord	8.4	10.7	...	...	8.2	10
Lancaster	9.5	11.8	...	....	9.2	11
Manchester	8.5	11.1	...	....	7.9	9.7
R. I.:						
Providence	7.8	10.1	6.7	9.2	7.1	9.0
Vermont:						
Burlington	8.1	10.4	7.5	9.8	7.5	9.2
Rutland	8.3	10.6	...	10	7.7	9.5

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).
†In steel barrels
Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

EXPORT PRICES

Effective June 4

	Mexican Gulf Ports U. S. Dollars per Bbl. Bunker C	Diesel
Tampico	$0.97	$1.65
Veracruz	0.97	....
Coatzacoalcos	0.97	1.65
	Pacific Coast	
Guaymas	$1.50	$3.22
Mazatlan	1.50	3.22
Acapulco	1.50	2.89
Manzanillo	1.50	2.89
Salina Cruz	1.50	2.89

Pacific Export

In Ship's Bunkers, or deep tank lots:

Prices in Effect	June 4	May 28
Diesel Fuel, Pac. Spec. 200	$1.45	$1.45
Grade C fuel, Pac. Spec. 400	$1.10	$1.10

	Bunker C Fuel Ships' bunkers (Ex Lighterage)	Diesel Oil Ships' bunkers (Ex Lighterage)	Diesel Oil Shore Plants	Gas House Gas Oil 28-34 Gravity
New Haven	$1.77	....	....	....
N. Y. Harbor	$1.77	$2.78	6.7 (1)	6.8 (2)
Albany	$1.97 (1)	$2.94 (1)	6.8 (1)	7 (1)
Philadelphia	$1.77	$2.78	....	....
Baltimore	$1.77	$2.78	6.7 (1)	6.7 (1)
Norfolk	$1.77	$2.78	6.7 (1)	6.7 (1)
Charleston	$1.72 (2)	$2.65 (2)	6.4 (1)	6.4 (1)
Savannah	$1.72 (1)	$2.52 (1)	....	....
Jacksonville	$1.72 (2)	$2.41 (2)	....	....
Tampa	$1.62	$2.41 (2)	....	....
New Orleans	$0.97	$1.65 (1)	4 (1)	....
Portland	$1.77	....	6.8 (1)	6.9 (1)
Boston	$1.77	$2.78 (2)	6.7 (2)	6.8 (2)
Providence	$1.77	$2.78 (2)	6.7 (1)	6.8 (1)

Bunker "C" when from Navy storage at New York and Norfolk to out-going vessels ships 05c discount. (Subject to cancellation.)

*—$1.05 semi-refined; 1.25—100% distillate.

Gulf Coast

Prices in Effect June 4

MOTOR GASOLINE	New Orleans & Lower Mississippi to Baton Rouge Tank Cars	New Orleans & Lower Mississippi to Baton Rouge Barges	Texas Gulf Coast South of New Orleans Tank Cars	Texas Gulf Coast South of New Orleans Barges	CARGOES Domestic & Export From all Gulf Ports
Leaded (oct. by ASTM)					
76 oct.	6.75	6.5	6.75	6.75	6.75
70-74 oct.	6 – 6.125	5.625	5.625–6.375 (a)	5.625	5.625
63-65 oct.	....	....	....	....	....
Unleaded 70 oct.	....	....	....	....	5.625
67-68 oct.	....	....	....	....	....
65 oct.	....	....	....	....	5.25
60 oct.	....	....	....	....	5
KEROSINE & LIGHT FUELS					
41-43 w.w. kero.	4.125– 4.25	4.125	4.125– 4.25	4.125	4.125
42-44 w.w. kero.	....	....	4.125	4.125	4.125
No. 2 fuel oil	3.75	3.75	3.75 – 4	3.75	3.75
DIESEL & GAS OILS					
(In diesel index No.)					
No. 5 fuel oil	$1.05	....	....	....	....
43-47 di.	....	....	....	....	4
48-52 di.	4	4	4	....	4
53-57 di.	4.125	....	4.125	4.125	4.125
58 and above	4.25	....	4.25	....	4.25

(a) 5.625c for Dist. 1 and 6.125-6.375c for other districts.
NOTE: Above products in Truck Transports of 2,400 gal. and over ½c above Tank Car Prices

Heavy Fuels & Bunker Oil (at all Gulf Ports) Heavy Diesels	In Cargoes	In Ship's Bunkers (Ex Lighterage)
Below 28 API Grav.	....	$1.35
28 & above API Grav.	....	$1.65
Bunker C Oil	$0.97	$0.97

Mid-Continent Lubes

(At Gulf; in packages, FAS.; in bulk, FOB terminals).

Prices in Effect June 4

	Steel Drums	Bulk
Bright Stock		
D color, Vis at 210°		
200 vis.	....	....
150 vis., 0-10 p.p.	32.65 (1&a)	24.8 (1)
100 vis., 0-10 p.p.	....	....
100 vis., 10-25 p.p.	....	....
Neutral—No. 3 color		
200 vis., 0-10 p.p.	....	....

(A) FAS at New Orleans.

Wax

(Melting points are AMP, 3° higher than EMP) Prices are FOB refinery and do not include bags; freight or export differentials).

Prices in Effect June 4

Crude Scale	New Orleans Export	N. Y. Domestic	N. Y. Export
124-6 Yellow	4.25 (1)	....	4.25 (1)
122-4 White	....	4.25 (2)	4.25 (2)
124-6 White	4.25 (1)	4.25	4.25
Fully Refined:			
123-5	5.2 (1)	5.2 (2)	5.2 (1)
125-7	5.2 (1)	5.2 (2)	5.2 (1)
128-30	5.6 (1)	5.6	5.6 (1)
130-32	5.85 (1)	5.85 (2)	5.85 (1)
133-5	6.15 (1)	6.15	6.15 (1)
135-7	6.4 (1)	6.4 (1)	6.4 (1)

Naphtha

Prices in Effect June 4

	V.M.&P. Naphtha	Mineral Spirits
New York Harbor	11 (2)	10
Philadelphia	11 (2)	10
Baltimore	10.5 (2)	9.5
Boston	11.5 (2)	10.5
Providence	11.5 (1)	10.5 (2)

CLASSIFIED

For Sale

FOR SALE: 50 heavy round steel signs 40 inches in diameter bound by 1½ inch strap-iron with clamps ready to hang. Write—Morden Oil Company, P.O. Box 717, Lansing 3, Michigan.

FOR SALE—1941 KS7 International Tractor and 1940 Progress Semi-Trailer, 3-compartments 3735 gallon capacity, 1000x20 tires on trailer, 900x20 tires on tractor, vacuum brakes, power pump. Entire unit in excellent condition, including tires. Christopher Oil Company, Tucson, Arizona.

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USED ROTARY DRIVE-ON HYDRAULIC LIFT
$175.00

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CHICAGO, ILLINOIS

TANKS FOR SALE

Five Pfaudler Tanks 7'6" diameter by 3'2" deep. Dished bottom. One Tank 7' diameter by 4'6" deep. Two Tanks 46' diameter by 20' high.

Empire Equipment Corporation
608 Empire Bldg., Cleveland 14, Ohio
Phone: Main 7667

TRANSPORT TANK TRUCKS
Complete Units

A few tractors in good operating condition, each complete with a 3800 or 4000-gallon semi tank trailer. This equipment now available for immediate sale in southeastern state.

Box No. 591

FOUR C & G COOPER gas engine driven gas Compressors. Size 18" x 20". Type 75. Compressor cylinder sizes 15", 16", 16½" and 17½". Good condition. Dismantled and ready for shipment.

The Globe Oil & Refining Co.,
Lemont, Illinois.

FOR SALE
STORAGE TANKS

Steel storage tanks ranging from 5,000 gallon to 30,000 Barrel capacity.
One (1) 200,000 cu. ft. Gas-relief Holder.

WE WELCOME ALL INQUIRIES

Empire Tank & Salvage Co.
1451 Broadway New York 18, N. Y.
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FOR SALE
2—Lodi model "C" Molds with 12 sets Matrix & Spacers size 450 thru 32 x 6 General Tread Design Regular and Mud-Snow.
1—Lodi R-1 Mold with 5 sets Matrix & Spacers all Mud-Snow design.
DEPENDOL GENERAL TREADING WORKS
Cumberland, Maryland

For Sale

TRACKSIDE STATIONS

Nine combination gasoline Bulk Plants and Retail Stations located on main traffic arteries in and near large midwest city. Priced to sell at much less than cost of replacement. Has been very profitable. Includes lubricating oil bulk plant—warehouse—trucks—office — all complete and modern. Attractive terms. $30,000 required for inventory and initial payment.

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National Petroleum News

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Competent grease maker with experience in grease making and lubricating oils by Elizabeth, N. J. independent oil company. Position permanent. State age, qualifications, experience and salary expected.

Box No. 606
National Petroleum News

WANTED

Operations Manager for small independent operator of trackside stations in mid-west. Prefer man about 40 with experience as supervisor of retail stations. Permanent, attractive opening for man able to produce results.

Box No. 604
National Petroleum News

Situations Open

CHEMIST OR CHEMICAL ENGINEER: To work with sales department, assist in developing new markets for light oil distillates. Experience in light oil distillates or petroleum preferred. Location East. State age, experience and draft status. Box No. 607.

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Chemical Engineer with refinery operation and construction experience. Must be capable of taking full charge of progressive independent refinery.

Box No. 602

GREASE SALESMAN FOR JOBBING TRADE

Responsible manufacturer of standard greases has opening for experienced grease salesman to call on the jobbing trade. Excellent opportunity for right man. Compensation, salary and commission. State fully experience.

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In Saudi Arabia

Refinery operators; graduate petroleum, electrical and mechanical engineers; stabilizer operators; combination welders for pressure vessel and pipe work; boilermakers and various other crafts; accountants; stenographers.

Employment offers opportunities for post-war security and advancement. Liberal benefit plans; vacations in United States; free hospital and medical care.

If genuinely interested in foreign career, send full information on experience, transcript of college record (professional applicants only), references, draft and availability status to our Employee Relations Department.

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Tremendous backlog of equipment needed by the industry. Butler Oil Equipment a leader in the field. Backed up by national advertising. Attractive compensation for men who produce.

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BUTLER MFG. COMPANY,
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ABOUT OIL PEOPLE

E. A. Wahlstrom, who resigned May 1 as director of production for Dist. 3 of the Petroleum Administration for War, has joined the Fort Worth office of the Gulf Oil Corp.

He will be division superintendent under **M. O. Rife,** superintendent of production for the Fort Worth district. The announcement was made by **F. J. Adams,** general agent for Gulf.

While director of production for Dist. 3, Mr. Wahlstrom was on assignment by the Navy, serving as a lieutenant.

° ° °

The Petroleum Administration for War announces the appointment of **E. E. Robbins,** of Tulsa, Oklahoma, as director of its Division of Materials. Mr. Robbins was formerly a special representative on petroleum materials for the United States Steel Export Co.

Mr. Robbins

The new director is replacing **Claud P. Parsons,** of Duncan, Oklahoma, whose resignation became effective June 5. Mr. Parsons will return to Duncan to resume his duties as Vice President of the Halliburton Oil Well Cementing Co. from which he was given leave in January 1944 to serve with PAW.

Mr. Robbins has had previous experience in solving wartime materials problems affecting the petroleum industry both with the PAW and the WPB in highly responsible capacities. His government service was preceded and followed by wide experience with both the domestic and foreign branches of the petroleum industry.

° ° °

C. E. Davis, general manager of the manufacturing department of Shell Oil Co., New York, has been elected a vice-president to succeed **J. F. M. Taylor,** vice-president in charge of manufacturing, the company announced last week. Mr. Taylor is resigning effective June 15, to return to California to devote his time to personal interests and consulting work.

Mr. Davis started with Shell in 1917 as a shipping clerk in the refinery at Cushing, Okla. In 1932 he was transferred to the main office of the company at St. Louis, and in the following year he became assistant to the manager of the manufacturing department. In 1938 he was made assistant to the vice-president in charge of manufacturing and in 1943 was appointed general manager of manufacturing.

Mr. Taylor, as wartime head of Shell's East of the Rockies manufacturing department, has in addition served on several petroleum industry committees. He is a member of the PAW Dist. 2 refining committee, the technical advisory committee of P. I. W. C., the general refining committee of the A. P. I. and is a director of the Coordinating Research Council, a joint committee of petroleum and automotive engineers.

° ° °

Murray Russell, formerly sales manager of the Oceco division of the Johnston & Jennings Co., Cleveland, has been appointed manager of the company's newly established office in Washington.

He has been succeeded by **C. J. Van Landeghem,** formerly sales manager of the Philip Carey Mfg. Co., Cincinnati.

° ° °

M. LeRoy Stoner has been appointed staff engineer of the Aeronautics department of the Society of Automotive Engineers, it was recently announced. Mr. Stoner, formerly chief of standards for General Motors' Eastern Aircraft Division, began his engineering career in 1939 with Standard Equipment Co. He received his engineering education at the University of Wisconsin and McKinley College.

° ° °

Mr. Kelley

Election of **Joseph A. Kelley** as vice president in charge of sales operations was announced last week by Cities Service Oil Co. (Pa.), eastern marketing subsidiary of Cities Service Co.

Mr. Kelley, who is a graduate of Massachusetts Institute of Technology and Harvard Graduate School of Business Administration, has been with the Cities Service organization for 20 years. He was with the Chemical Warfare Service during the last war.

° ° °

Col. J. F. Drake, president Gulf Oil Corp., Pittsburgh, was elected chairman of the Conference Board, to succeed **S. Clay Williams,** chairman, J. R. Reynolds Tobacco Co., Winston-Salem, N. C.

° ° °

Edwin J. Freeman, Jr., son of E. J. Freeman of Acme Petroleum Co., Chicago, has been promoted to technical sergeant and awarded another star for combat service, he reported in a letter to his parents. He is stationed near Dijon in France. The latest honor, a bronze star, is his sixth combat award. He won a Presidential citation and Croix de Guerre last November.

Al Hapke, Jr., has joined the staff of the American Petroleum Industries Committee of the American Petroleum Institute, to head its newly created aviation section, according to an announcement by **B. H. Markham,** the Committee's director. The new section will concern itself with problems relating to taxation, the financing of aircraft landing facilities, and related matters.

Mr. Hapke

Before joining the Committee's staff, Mr. Hapke was market research manager for Republic Aviation Corp., and in this capacity participated actively in the work of the various aviation trade associations. From 1940 to 1942, he was advertising manager of the Bell Aircraft Corp., Buffalo, N. Y., and prior to his affiliation there was on the Chicago advertising staff of Collier's magazine. In 1936 and 1937, as a pilot for Pan American Airways, Inc., he flew all of the Eastern Division's routes through the Caribbean and South America.

Mr. Hapke is a Quiet Birdman, a member of the Wings Club, the Institute of Aeronautical Sciences, and the Aviation Committee of the American Market Assn. He graduated from Yale University in 1933 and is a native of Milwaukee, Wisconsin.

° ° °

The Bronze Star Medal has been awarded to **Major Richard F. Holt,** former Tire, Battery and Auto Supplies Supervisor for Tidewater Associated Oil Co., and to **T/4 Walter S. Booth,** also associated with Tidewater's Domestic Sales Department office staff, it was announced recently at 29th Tactical Air Command Headquarters in Germany.

The citations were given for "meritorious service in direct support of combat operations against the enemy."

° ° °

Two hundred golf enthusiasts will compete for two awards for low gross in the annual Twin City Petroleum Club golf tournament at the Minneapolis Golf Club June 12.

B. D. Dawson of the Tonsel Oil Co. and **Sherm Burnap** of Direct Service Oil Co. are in charge of ticket sales and management while **Stan Larson** of Brown Steel Tank Co. is in charge of golf.

Ralph Ormsby of Ethyl Corporation will be toastmaster at the banquet.

Winners in last year's contest were **W. D. McColly,** Pure Oil Co. and **Charles Nix** of Northwestern Refining Co.

Some Thoughts Between

V-E DAY and V-J DAY

"SO THEY are already moving the First Army to the Pacific . . . they more than lived up to their name in France . . . half a million washing machines will be released for production this year . . . wonder how many points it takes for a company to be discharged from war work? . . . is one star on your "E" flag equal to a service stripe or a decoration?"

Silly thoughts! Maybe—but no more so than many we hear and see in print. This we *do* know—America is not safe until V-E Day has been followed by V-J Day and, as long as we can help, our experience, our manpower and our facilities are at the disposal of our Armed Forces.

Smug flag-waving? No! We want to reconvert. We don't like war work any better than you do. But we want our return to civilian work to be complete and permanent.

Fortunately, reconversion is no real problem to us. One week and we'll be 100% on truck and trailer tanks. After V-J Day all we've got and all we've learned (and it's been plenty) will go into making our post-war tanks the best we've ever made. We hope you'll bear with us.

FARRELL MFG. COMPANY

Joliet, Illinois

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Many a wholesale blender has discovered that he can greatly simplify his purchasing and production problems . . . and *save money* . . . by standardizing on "the multi-purpose blending stock" . . . SUN No. 96. This one high quality, golden stock is an ideal blending base for *five* different products. It is tough, durable, free of acidity, non-corrosive and low in carbon content. Check over these five types of lubricants and judge for yourself how much time, trouble and expense *one* blending stock for all *five* would save you. Then write for complete information, *today*.

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① Truck Oils

Sun No. 96 is ideal for blending truck oils that are low in carbon content, free from corrosive acidity and long-lasting. It will help you to get a big share of this profitable wartime and postwar market.

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Sun No. 96 offers every characteristic necessary to blend pure, low-carbon, durable oils and greases for use in almost all types of farm machinery and implements.

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④ Specification Lubricants

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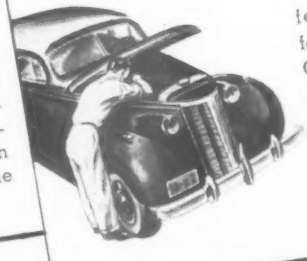
Sun No. 96 is a perfect blending base for use with 200 Vis. Coastal stock to produce low-carbon, non-corrosive automotive oils . . . SAE 20 to 50.



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TECHNOLOGY DEPT.

NATIONAL PETROLEUM NEWS

Monthly Technical Section Devoted to
REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY

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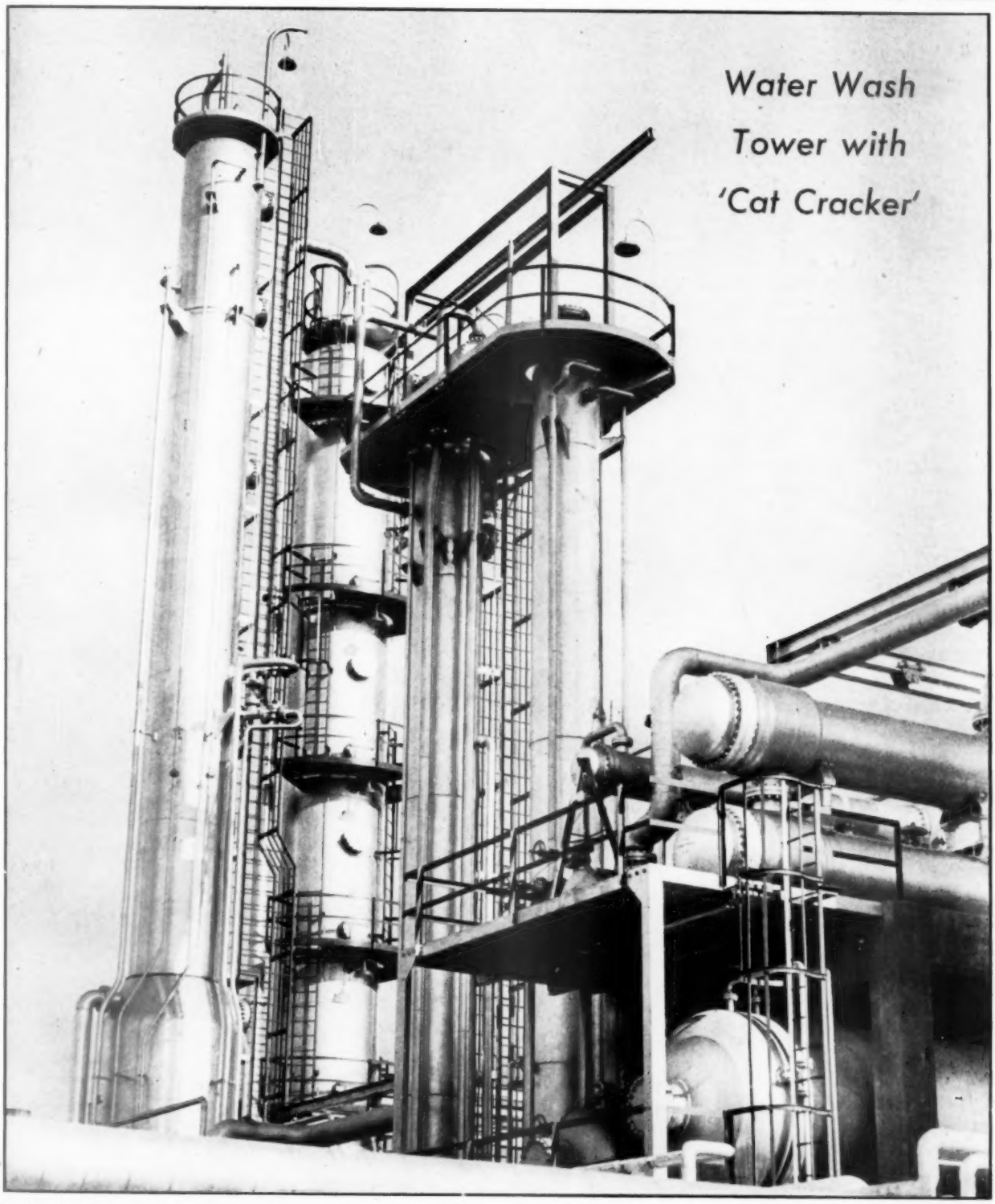
Section Two

June 6, 1945—Vol. 37, No. 23



Water Wash Tower with 'Cat Cracker'

An 84-in. diameter by 24-tray water wash tower at Tide Water Associated Oil Co.'s new Avon (Calif.) Fluid catalytic cracking plant is used to remove water-soluble impurities from the gas and gasoline products of the cracking reaction. The tower is shown above, second from the left. To its right are the regenerator and absorber for a Girbotol hydrogen sulfide removal unit, and to the left the main gas plant absorber. See p. R-406 for details.

The above pictured Hudson induced draft cooling tower, designed to cool approximately 30 million gallons of water per day under adverse Gulf Coast atmospheric conditions, is installed in the Great Southern Corporation Aviation Gasoline plant on Corpus Christi Bay.

The distinctive Hudson quality features in design and construction which resulted in the selection of a Hudson Tower for this installation, assure long, low cost, trouble-free operation.

HUDSON ENGINEERING CORPORATION

Fairview Station, Houston, Texas

HUDSON COOLING TOWERS

MECHANICAL AND NATURAL DRAFT

Contents

National Petroleum News, TECHNICAL SECTION

Vol. 37, No. 23—June 6, 1945

Features

Program for Loss Control in Manufacturing and Handling Operations R-403
By J. H. McClintock and R. S. Piroomov

24-Tray Water Wash Tower Removes Ammonia and Hydrogen Cyanide from "Cat-Cracker" Products R-406

Alkylation—Backbone of Aviation Gasoline R-407
By Wm. Mendius

Four Neighboring Refiners Install Joint Catalytic Cracking Unit R-410
By Paul Truesdell and W. E. Lemen

8250 b/d Canadian Refinery Is Complete, Even to Modern Lube Oil Manufacture R-417

Chemical Utilization of Natural Gas R-430
By Benjamin Miller

The TCC Catalytic Cracking Process for Motor Gasoline Production R-441
By R. H. Newton, G. S. Dunham and T. P. Simpson

Tank Bottoms Seen as Source of Microcrystalline Waxes R-460
By Ernest Stossel

Kinetics of the Process of Thermal Polymerization of Butadiene R-466
By S. V. Lebedev, M. A. Khokhlovkin, N. I. Kuibina and others

Hydrocarbon Reference Samples Are Listed R-486

263-Ton Hortonsphere Built on Timber Bed, Moved 800 Ft. Intact R-487

Semi-Annual Index of Refining Technology Articles
Subject Index R-490
Author Index R-493

Departments

Industrial Lubrication R-438
2—Lubrication of Steam Turbines
By W. G. Forbes

Keeping Up With the News R-454

Petroleum Technologists in the Armed Forces R-478

Technical Meetings for Oil Men R-488

Advertisers' Index R-495

Widening Horizons R-496
"Converting Thermal Plants to Catalytic Operations"
"New Technique for Flame Combustion Photography"

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PREVIEW

Feature Articles Coming Next Month

• • •

Pierced Plate Towers Avoid Chemical Carryover

A typical example of the use of a pierced plate contacting tower as adopted in one large refinery for treating hydrocarbons with chemical solutions is described by two of the company's engineers. These towers have proved efficient countercurrent extraction units and their operating costs are said to be low as compared with those of conventional orifice mixing columns.

Full Scale Fire Tests With Water, Mechanical Foam

To test on a full scale some of the newer methods of controlling oil fires, one of the large refining companies recently sponsored a four-day test program with the cooperation of several manufacturers of fire-fighting equipment. Both water spray and mechanical foam were used as extinguishing agents, and exhaustive engineering data were recorded during the tests.

The complete report of the equipment used, the results of the individual tests, and the technical information gathered will be presented in the July TECHNICAL SECTION.

Lubricants by Synthesis

Despite the fact that the need for the development of synthetic lubricants is not urgent in this country, many oil companies for years have displayed interest in this subject as evidenced by the research work. Developments in this field are surveyed in a comprehensive article which includes an extensive bibliography and listing of patents.

For Future Reference

As a convenience to those of our readers who make written reference to articles and papers appearing in the NPN TECHNICAL SECTION, we are with this issue incorporating a change in the date line appearing on each right hand page. Instead of giving only the date at the bottom of the page, we have added the current volume and issue number.

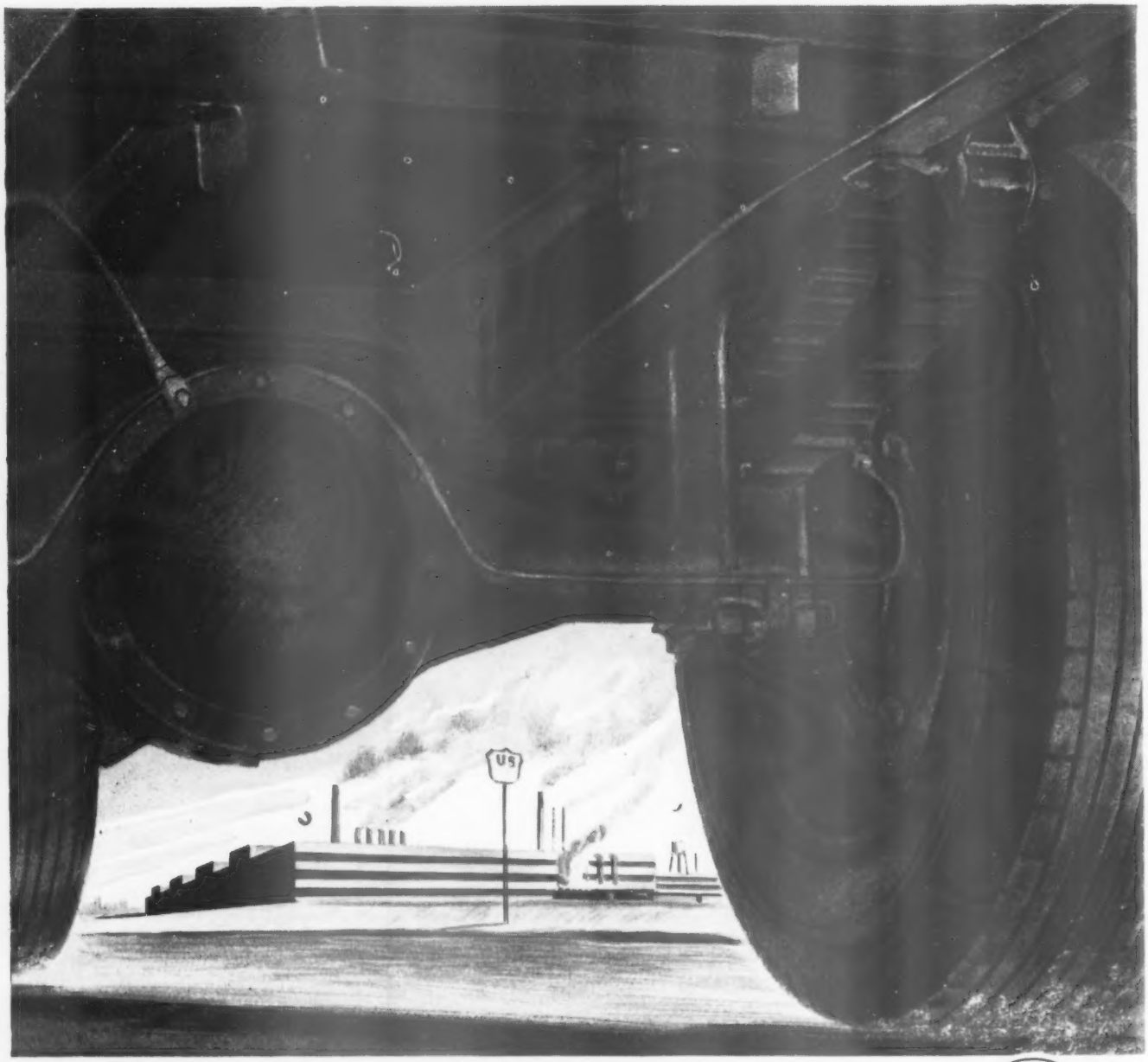
We are indebted to Mr. M. Ehrlich, chief chemist for American Lubricants, Inc., for the suggestion that we make this change to eliminate the need, as he puts it, of "scouting back to page one to find the volume and issue number, and then returning to the article to finish reference."

THIS IS THE WAR PLANT the truck built

TRUCKS brought in the lumber, steel and cement that went into the construction of this war plant. Trucks carried the machines that crowded out the cows. Now trucks are feeding the production line with raw materials and hauling away the finished products... day and night, rain or shine.

The trucking industry can justly be proud of its wartime accomplishments. Overcoming the difficulties caused by shortages of skilled manpower, parts and new equipment, truck operators have contributed greatly to the tremendous task of winning the war.

The war has brought home how important a part gasoline plays in the transportation system of this nation. We of Ethyl are glad to have been able to contribute to the improvement of engines and fuels and look forward to continuing cooperation with both manufacturers and operators of trucks in the future.



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REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY

June 6, 1945
Volume 37
Number 23

MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS *incorporating International Petroleum Technology*

PROGRAM for LOSS CONTROL
In Manufacturing and Handling Operations

By J. H. McClintock and R. S. Piroomov
Technical Service Division, Standard Oil Co. of New Jersey

Recognizing that modern complex refining operations have made the balance between quantity of crude run and quantity of products obsolete for loss control purposes, a method of "anticipated recovery" based on 100% weight balance has been adopted as standard procedure for determining manufacturing losses. Other steps in the program include isolating the source of loss in handling as well as refining operations, and the development of methods for the reduction and continuing control of losses.

DURING the past several years the Standard Oil Co. of New Jersey and its affiliated organizations have pursued a comprehensive program of oil conservation as applied to the manufacturing, transportation, and distribution phases of their operations. This program constitutes an integral part of the overall program to conserve the nation's petroleum resources.

Conservation work in the handling of petroleum had been carried out for many years prior to the initiation of the program described here, but most of the activities had been directed toward the evaluation and control of well-known loss sources. For example, numerous tests have been conducted to determine the factors affecting the rate of evaporation of volatile materials from tankage. Results of this work were and are valuable in selecting proper type tankage for new construction and in the replacement of and repairs to existing tankage, but they had no application to daily refinery operations. Other loss sources were subjected to technical study only when their magnitude was so readily apparent that a remedy became imperative. No adequate provision was made for a systematized investigation of all possible loss sources and their eventual reduction or elimination.

The program of loss control as now applied in Jersey's plants consists of three main phases, viz:

(1) **Determination of the magnitude of the total loss.**
(2) **Isolation of all loss sources and the development of means of elimination or reduction of the losses.**
(3) **Application of a system to control the losses within reasonable limits.**

Before an intelligent analysis of individual losses can be made, it is first necessary to know the magnitude of the total loss for a given plant. In terminal plants, the accounts are usually maintained on the basis of shell gallons whereas, for stock loss control, the accounts must be balanced at a common base temperature (usually 60°F.). When it is recognized that a 10°F. change in temperature can change the volume of the commodity being handled by from 0.4% to 0.7%, it will be agreed that the normal shell gallon balances, while adequate from an accounting standpoint, do not constitute a good basis for the determination of the magnitude of actual product loss in the terminal.

In a refinery the problem is much more complex. The evolution of refining processes has had considerable effect on the utility of the refinery yield statements as a measure of refinery loss. During the early period in refining, when the operations consisted chiefly of a simple separation of crude petroleum into its various "cuts", the refinery yield statement consisted of a simple balance between the quantity of crude run and the quantity of the products. The difference between these two quantities, after correction for inventory change, was at that time fairly representative of the loss and was so shown on the statements. This same general procedure, with but few minor modifications, has been carried over in most refinery yield statements to the present day.

Where refineries are conducting such complex operations as cracking, alkylation, polymerization, hydrogenation, isomerization, etc., all of which exert an effect in different degrees and in different directions on the density and state of the raw materials processed, the general refinery yield statement is as antiquated for loss control purposes as are the refining processes for which it was originally designed. The result is that the so-called "loss" from the yield statement bears no relationship to the real plant loss in a modern refinery.

During the initial stages of the conservation program in the refineries of the Jersey interests, serious consideration was given to the use of weight balances. Simultaneously, a procedure was developed which was designed to utilize the refinery yield statements to the maximum possible extent by making necessary compensations for the state and density changes in the processing operations. This procedure involved the development of correlations evaluating the effect of all major variables on the total recovery for each process so that an "Anticipated Recovery" could be determined which would take into account the effect of changes in the operations on the volume (liquid products) and weight (gaseous and solid products) yield. A number of changes in the regular yield accounting procedures were also required to insure a common basis of calculation and to permit a direct comparison between the total refinery recovery as shown on the refinery yield statement and the calculated anticipated recovery. The difference between these two values was representative of the true refinery loss.

Several checks between the losses determined by the weight balance and the losses determined by the "Anticipated Recovery" procedure have indicated

good agreement between the two methods. However, disadvantages were associated with the weight balance in that a large number of additional calculations and laboratory inspections were required which, in a large plant, made this procedure prohibitive. For this reason, the method of "Anticipated Recovery" was adopted as the standard procedure for calculating the loss at all of Jersey's refineries.

Since the anticipated recovery calculated for each of the various operations is based on a 100% weight balance (no loss) there is no allowance for "normal" processing loss in the calculation. For this reason, the total refinery loss can be determined as the difference between the total refinery yield from the accounting statement and the "anticipated recovery". As a simple example to illustrate this principle, let us consider a plant processing crude by simple separation methods at a rate of 50,000 B/D. According to the yield statement the recovery is 98% by volume (liquid products) and 1.5% by weight (gaseous and solid products) for a total recovery of 99.5%. The "anticipated recovery" is 100% and actual loss 0.5%, equivalent to about 250 B/D. However, if operations included thermal cracking of 25,000 B/D of gas oil and reduced crude at an average anticipated volume plus weight yield of 102.0%, the "anticipated recovery", neglecting fine adjustments, would be calculated as follows:

$$100.00\% + (25{,}000/50{,}000) \times (102.0 - 100.0) = 101.00\%$$

In this case the real refinery loss is 101.00% — 99.5% = 1.5% or 750 B/D rather than the apparent .5% or 250 B/D. With recognition of the real loss, the economic incentive for improving loss control is tripled.

The isolation and evaluation of individual loss sources making up the total plant loss constitutes the second step in the conservation system. By this means, loss control activities can be concentrated on the most important sources first and methods devised to reduce or eliminate these losses. During the initial stages of Jersey's work on refinery losses as much as 80% of the loss in some of the plants was unaccounted for. During the past several years this item has been reduced, in some plants, to less than 10%.

Plant investigations of loss sources in the refineries have been carried out largely by technical men assigned exclusively to this problem. Actual test work on all loss sources in the refinery is conducted and /or supervised by these refinery conservation engineers and periodical reports on the activities are presented to the local management. These reports usually present the status of the work on all important loss sources and action is recommended on those items of primary importance.

Once the losses are reduced to the economic minimum in any plant the final step in the program is to set up a system to control these losses within reasonable limits. Many of the improvements made to reduce the losses have been attributable to improved maintenance of equipment and it has been necessary to maintain a periodic checkup on such equipment to preclude recurrence of these loss sources. Other reductions in the losses have resulted from changes in the processing or handling methods and controls were devised and maintained to guard against retrogression in this field. Jersey's experience has demonstrated that the conservation program is incomplete without regular and frequent checkups on old loss sources and a continuing investigation of new sources of losses.

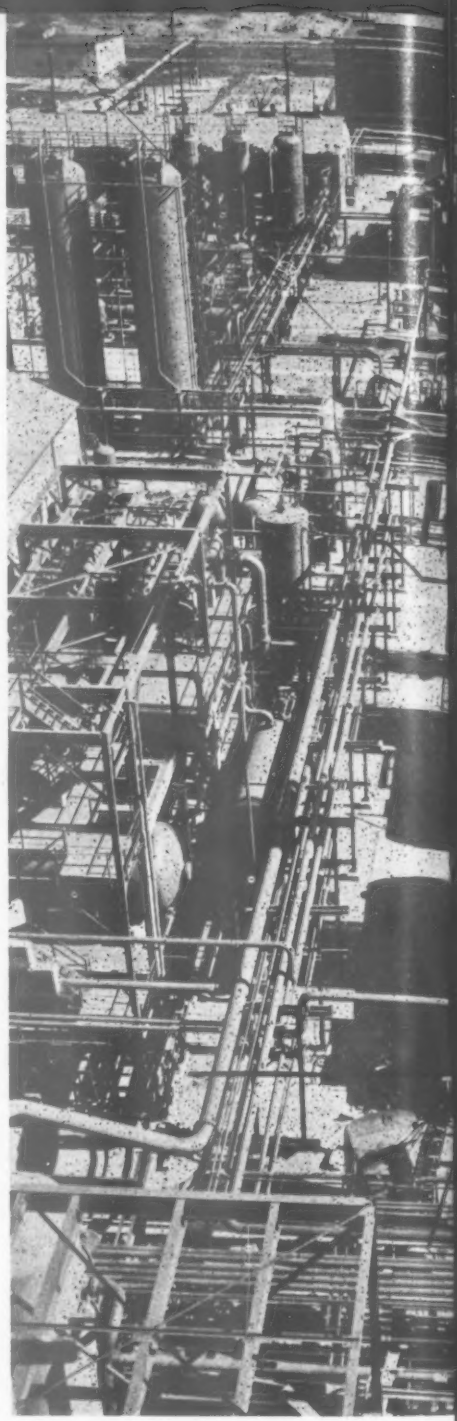
Transportation Operations—Tank Cars

So far, the discussion has concerned losses in manufacturing and storage, whereas a comprehensive conservation program must include the control of losses in transportation operations. As a matter of fact, the complete control of losses in the refineries and storage terminals was found to be impossible without an accurate method of measuring transportation losses on the movement of products between Jersey's plants and in the purchase and sale of crude and products. Measurement inaccuracies have also been found to be the major contributing factor in the confusion and controversies relative to losses in purchases, exchanges and allocations during the past several years.

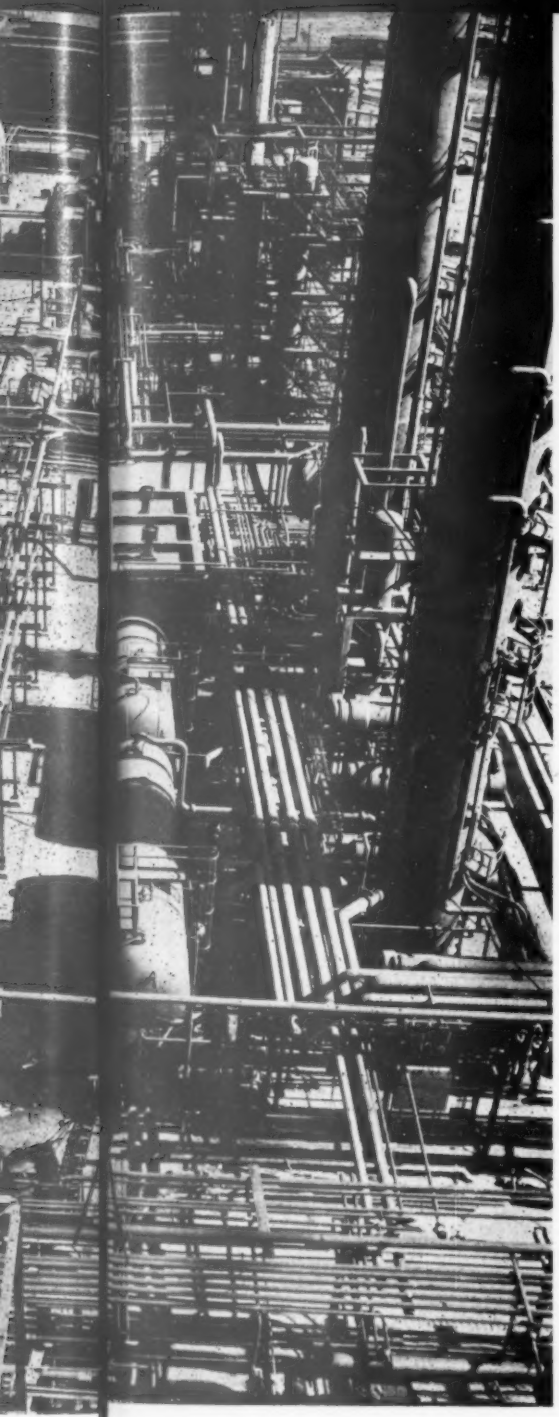
In 1941, even before the U. S. entered the war, Jersey had initiated large volume movement of crude petroleum to the Atlantic seaboard via tank car, so that losses occurring in tank car operations (loading, in transit, and unloading) were considered as among the first in the study of transportation losses.

From tests conducted on hundreds of tank cars handling crudes and non-volatile products, it was determined that the physical losses in tank car operation were negligible. However, inequities of appreciable economic magnitude and very definite reductions in tank car carrying capacity were found to be associated with the operations on crudes and viscous products due to air inclusion in the oil and air entrapment in the tank cars on loading, and to oil remaining in the cars as residue and sidewall cling after unloading. These difficulties were

Losses in storage because of evaporation of volatile materials have long attracted the attention of refiners. Tests to determine the factors affecting these losses have been valuable in the selection of proper type tankage for new construction and in repairing existing tankage.



Modern refining operations, such as light end recovery and alkylation shown above, have made obsolete for loss control purposes the former practice of taking the difference be



tween quantity of crude run and quantity of products produced as truly representative of manufacturing losses. (Baltimore refinery of Standard Oil Co. of New Jersey)

augmented by the rapid car turnaround prevailing in the industry-wide effort to minimize tank car loading and unloading time. Some plants recognized this situation and revised their tank car loading procedures to alleviate the inequities. On the other hand, some plants made no special effort to compensate for these changed conditions. The result was that many inaccuracies and inconsistencies occurred in the operations.

In order to insure accurate measurement of all tank car receipts at their plants, Jersey initiated a program designed to educate tank car loaders and unloaders in the art of accurately measuring tank car quantities. In addition, especially trained tank car inspectors were assigned at Jersey's major East Coast plants to measure all receipts via tank car in an effort to assist in tracing down the reasons for these inequities. Close cooperation was maintained with governmental agencies concerned with the movement of petroleum products to the East Coast during this entire program and the procedures developed and used were accepted and in most cases adopted by the inspectors associated with these agencies.

The fundamental data obtained from this test program, the experience gained in the plants through the application of this measurement control system, and the methods of measurement and measurement equipment which were developed over this period of what has been the largest volume transfer of petroleum in tank cars in the history of the industry, have, at the request of the American Petroleum Institute been outlined for the entire industry preliminary to the preparation of an API code covering the "Measuring, Sampling and Calculation of Tank Car Quantities". Representatives of the organizations interested in this project are preparing a preliminary draft of the code to the end that many of the more efficient tank car handling methods and the "know-how" developed during the emergency period can be utilized to increase the tank car handling efficiency when the industry returns to normal peacetime tank car operation.

Barges

Another mode of transportation which has been under study for improved loss control is barging. The erratic nature of the apparent stock variations in barge operations is well known to the refinery, terminal and bulk plant supervisors, and needs no discussion here. Since the industry had no better answer to this problem, a shortage of .5% by volume has been deemed acceptable to the trade although it has been recognized that this allowance appreciably exceeds the real loss in a majority of the cases.

In actual fact, it should be possible to transport non-volatile products of the kerosene-heating oil type in tight barges for voyages of as much as one week with a loss of less than .2% by volume. Careful checks made on barge transfers of crude oil and polymer gasoline between Boston and New York have shown losses in the magnitude of 0.07%. On other operations not so well controlled, losses of several per cent are not unusual and gains of this magnitude frequently are reported. Where such large fluctuations occur in individual transfers, no control can be exercised over the barge losses.

It became apparent early in the study of barge operations that there was a distinct need for a reference measure of the volumes handled. Under normal circumstances the barge intake and outturn quantities are determined by gauging the shore tanks at the refinery, terminal, and/or bulk plant. It was recognized that errors could occur in the measurement of quantity on either loading or discharging due to limitations or potential inaccuracies associated with the available equipment. For example, in many cases the shore tanks at a refinery or a large bulk terminal at which barges are loaded are located at a considerable distance from the dock so that the problem of insuring completely filled or completely empty lines was always present, constituting a source of error. Further, the shipping tanks at many of the plants are of relatively large size and the normal 1/16 in. or 1/8 in. gauging error constitutes a large per cent of the volume shipped.

While, in general, smaller tanks and shorter lines are used in the bulk plants, it is quite frequently necessary to continue operations even when discharging cargo. In these cases the measurement of the outturn is subject to potential errors and consequently the accuracy is subject to question in any controversy. In view of these potential sources of inaccuracy, it was necessary to develop a method of checking the conventional tank quantities. Displacement type meters appeared to have merit in view of the satisfactory performance shown in pipeline operations and serious consideration is being given to more extensive use of this type of meterage equipment in post-war operations. However, with the limitations imposed by war, the solution was, of necessity, confined to improving the accuracy of measurement

Physical losses in tank car operations are negligible, but air inclusion in the oil, air entrapment in the car, and oil remaining in the car as residue or clinging to the walls represent sizable discrepancies, besides reducing a car's carrying capacity. Careful inspection and a training program for tank car loaders has been Jersey's answer to these problems.

by more efficient utilization of available facilities.

The refineries and terminals had noted, over a period of years, that certain barges were "good" barges, i.e., the shore tank quantity appeared to check the quantity as calculated from the barge ullages and calibration tables quite frequently. However, no complete statistical analysis had, as far as is known, been made of the accuracy of the barge quantities. These observations by the plants on the accuracy of some barges suggested the possibility of using the barge quantity as a reference measurement on barge transfers. With this in mind, comparisons were prepared of the shore tank intake and outturn quantities and the barge quantities after loading and before discharging on a large number of barge transfers. This analysis indicated that good agreement between the shore tank and barge quantities was obtained on certain barges when both the shore tank and barge were measured carefully and accurately.

On other barges an appreciable deviation between these quantities was noted; but analysis indicated that, with accurate measurement, the deviation remained fairly constant. By a process of statistical analysis, it was possible to develop barge performance factors for many of the barges so that the accuracy of the shore tank intake and outturn can now be checked for each transfer and any necessary adjustments made to insure accurate billing and receipts.

As a result of this procedure, many of the reasons for shortage claims have been eliminated and, in the cases where claims are made, an analysis can be prepared and a reasonable and logical decision reached on the merits of the claim. Since this method of handling shortage claims has been initiated, there has been no case of any expressed customer dissatisfaction with the decision reached. More important from a loss control standpoint, is the fact that accurate barge quantities constitute a means for improving stock loss distribution and thereby aid in stock loss control.

Jersey's experience over the past several years has indicated conclusively that certain barges are accurately calibrated and can be used under proper conditions as a measure of quantity which is at least as accurate as that possible with many shore tank installations. Other barges have been found to be quite inaccurate. This variation in the accuracy of the vessels can be traced to the fact that there has been no concerted demand by the petroleum industry for accurately calibrated barges. However, some of the more advanced barge owners are recognizing the desirability, and in some cases the necessity, of having accurate calibrations of the cargo tanks on their vessels and have recently been having vessels in their fleet recalibrated whenever an opportunity arises.

Many of these barge owners are also attempting to eliminate potential sources of inaccuracies in the measurement of their vessels by installing ullage plugs in the center of the compartments, installing ullage wells, inserting air vents in cargo tanks to eliminate or reduce air entrapment, etc., while still others are providing correction tables to their calibration charts to compensate for the trim and list of the vessel at gauging.

Other transportation operations under study in Jersey's conservation program include tankers, pipeline and tank truck losses. However, since the problems involved and the principles on which the solutions are based are substantially the same, no further discussion is necessary.

In view of the importance of accurate measurements of quantities in the loss control program, Jersey has also initiated a company-wide program designed to standardize the procedures and equipment used in all measurement operations and to educate the field personnel in the art of measuring petroleum and its products. Existing standards have been carefully reviewed and summarized and new equipment and procedures have been designed, where necessary, and the final standard procedures issued in pocket-size pamphlets to the field personnel.

Conclusions

To summarize, Jersey's oil conservation program in the manufacturing, transportation and distribution operations is predicated upon the principle that it is essential first to know what the real losses are before they can be effectively controlled. Once the magnitude of the real loss has been established for any operation or series of operations, the technical analysis of the sources and means of reduction and control can go forward in a sound manner.

This Month's Cover

24-Tray Water Wash Tower Removes Ammonia and Hydrogen Cyanide from "Cat Cracker" Products

A FEATURE of novelty in the gas recovery plant erected as part of the Tide Water Associaated Oil Company's Avon (Calif.) Fluid catalytic cracking plant installation (*NPN Technical Section*, March 7, 1945. p. R-174) is a water wash tower to remove ammonia and hydrogen cyanide from the products of catalytic cracking. These compounds are formed in varying percentages depending upon the content of nitrogen in the feed stock, the type of cracking catalyst used and the operating conditions in the catalytic cracking plant.

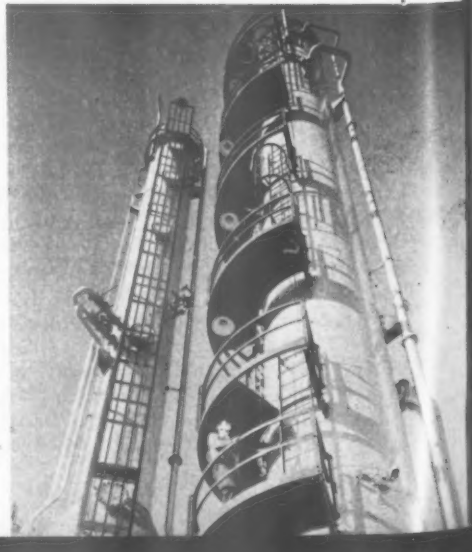
The water wash tower is an 84-in. by 24-tray column. Gas from the first stage of compression at approximately 45 lbs. gauge pressure enters through a distributor located below the first tray. The gasoline condensate from the main fractionating tower of the catalytic cracking plant enters the tower just above the third tray. One hundred to three hundred gallons per minute of wash water enter the tower above the 24th bubble tray, flowing downward and contacting the gas and gasoline and washing out water-soluble compounds.

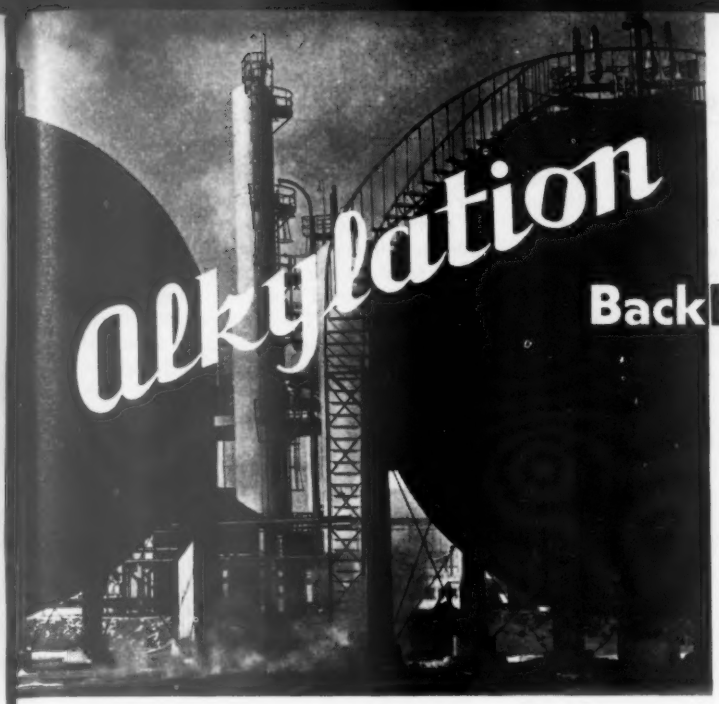
The washed gases, in leaving the tower at the top, pass through a packed section containing 2-in. stoneware raschig rings and thence into the interstage scrubber for the final stage of compression before entering the absorber-demethanizer column for further processing.

The gasoline stream, after contacting the gas and partially saturated wash water, drops down through a packed section in the bottom section of the column which contains 1-in. stoneware raschig rings for further mixing with the wash water. The foul water containing the ammonia and cyanide compounds is separated by means of an interface liquid level controller and dumped to the sewer, and the washed gasoline product is pumped into the absorber demethanizer column for further processing in the gas recovery stabilizer plant.

The Avon water wash system effectively removes all undesirable water-soluble reaction products in the catalytically cracked streams entering the gas recovery stabilizer plant, increasing its efficiency and improving the product quality.

Below—Closeup of the water wash tower, with the gas absorber in the background





Backbone of Aviation Gasoline

By Wm. Mendius

The importance of alkylate in the aviation gasoline program comes from two facts—its production is sizable and, since it has octane ratings appreciably higher than the current standard for war-grade aviation, it is able to carry base stock considerably in excess of its own volume. Total output at present is around 130,000 b/d, of which two-thirds is from sulfuric acid type plants and one-third from hydrofluoric acid plants. A general review is given of the characteristic differences in operation involved when using the two acids, as well as of some of the operating problems and the use of material.

IT REQUIRES no imagination to realize what an important part aviation gasoline is playing in the present war. We get an almost daily reminder of this, ranging from the spectacular Doolittle raid on Japan and the mass attack of 2000 to 3000 or more of our planes on what was once-termed Fortress Europe to the scouting missions of lone cub planes, and the flying of our wounded from battle zones to hospitalization areas.

The aviation gasoline used by our armed forces is a blend of many hydrocarbons of the C_5 to the C_{10} range from the paraffin, aromatic, naphthene, and olefin series, plus tetraethyl lead. With minor exceptions, these hydrocarbons are not blended as individual compounds but exist as components in the various types of stocks which are blended for finished aviation gasoline production. These stocks are classified under two groups, namely, base stocks and blending agents.

The base stocks, which have octane ratings on the low side of the pattern, consist mainly of materials produced by catalytic cracking and from straight-run sources.

The blending agents, which have octane ratings appreciably higher than aviation gasoline and consequently have the power to carry larger quantities of base stocks, consist in major part of alkylate, together with minor quantities of hydrogenated codimer, hydrogenated acid polymers, and aromatics.

Alkylate may therefore be rightly claimed the backbone of aviation gasoline, since its production is sizable. Also, since it has octane ratings appreciably higher than the current standard for war-grade aviation, it is able to carry quantities of the base stocks considerably in excess of its own volume.

Alkylate as herein discussed is that product falling within aviation boiling point range produced by the exothermic reaction of one or more of such unsaturates as propylene, butylenes, amylenes, or condensation products from the polymerization of butylenes with isobutane, using either sulfuric acid or hydrofluoric acid as a catalyst.

Basically the alkylation process effects the combination of one mol of isobutane with one mol of the C_3-C_4 or C_5 olefin or its equivalent in the form of olefin polymers to form one mol of alkylate.

Commercial alkylation was started in this country around 1938. These early plants used sulfuric acid. It was not until after our entry into the war in the latter part of 1942 that the first commercial HF plant was put into operation.

60 Units in Operation

Today approximately 60 alkylation units are in operation, producing approximately 130,000 b/d of aviation alkylate. Of these, about 60% are of the sulfuric acid type which account for around two-thirds of this production. The HF units comprise about 40% of the total and take credit for approximately one-third of the over-all production.

Alkylate is produced commercially in all types of units by very intimately mixing the feed stocks containing the olefins and isobutane, in as high a concentration as practical, with recycle isobutane and acid catalyst at a controlled temperature. This mixture is then routed to a settler, where the acid is settled out for reuse, with adequate facilities provided for the maintenance of proper acid strength.

The acid-free hydrocarbon product is passed through a series of distillation operations to recover, with minimum loss and at high concentration, all unreacted isobutane (which is used as recycle), to reject all other saturated hydrocarbons (which occur as contaminants in the raw feed stocks and which are not desired in aviation gasoline), and to make the proper separation of the alkylate produced into aviation alkylate and so-called heavy alkylate.

It is not the intention of this discussion to deal with the relative merits of the several types of equipment used in the alkylation units currently in operation. A general review of the characteristic differences involved when using the two acid catalysts previously mentioned, and of the operating problems and use of material, is considered to be in order, however.

Because of longer operating experience, sulfuric acid alkylation units have encountered fewer operating and maintenance difficulties than the HF units. Also, under the operating conditions involved, sulfuric acid is less corrosive to commercial equipment than is HF. Another point of difference is that acid catalyst regeneration is not employed directly in connection with a sulfuric acid alkylation unit, whereas this operation is an integral part of an HF alkylation plant.

In sulfuric acid alkylation no consistent operational troubles are being encountered. Acid settling difficulties have been experienced from time to time. These are largely a result of insufficient settling time because of extended unit thruput, or the use of fresh acid which contains too high a concentration of carbonaceous material when such acid is obtained by certain regeneration processes used in reclaiming spent acid, or the formation of too tight an acid-hydrocarbon emulsion in the reaction phase of the process due, in some cases, to obscure emulsifying agents.

Sulfuric acid of 95 to 99% strength is used as fresh acid supply. Such acid is either clean white acid, or regenerated acid produced by the hydrolysis and concentration of spent acids from the alkylation process or from light oil or lube oil treating operations. The concentrated acid must then be fortified with fuming acid to bring it up to the strength suitable for alkylation purposes.

Acid is rejected at strengths ranging

Presented before the Petroleum Panel of the Chicago War Production Conference, March 29. *William Mendius is with the Development Dept., Sinc'air Refining Co., East Chicago, Ind.*

from 85 to 91% titratable acidity. Reduction in acid strength is due partially to hydration and partially to formation of acid tars. In cases where the rejected spent acid cannot be used for other treating purposes or where, due to uneconomical transportation, it is not feasible to regenerate it, disposal of alkylation spent acid is a problem.

Reaction temperatures range from 40 to 70° F., depending on the ratio of production rate to refrigeration capacity and on the efficiency of the cooling systems, particularly during the summer season when cooling water temperatures are generally high. Removal of the exothermic heat of reaction at these temperatures is effected by indirect cooling using standard compression or absorption refrigerating systems employing ammonia or a hydrocarbon gas, such as butane or propane, or by auto-refrigeration wherein the heat is carried away by the partial evaporation of the lighter hydrocarbons in the reaction zone.

The sulfuric acid plant employs no special engineering materials. Carbon steel equipment is used throughout. Very little corrosion is encountered except in special cases.

As pointed out earlier, HF alkylation operations have given considerably more trouble. However the HF "know how" is being rapidly acquired and it should not be long before most troublesome factors will be overcome. At the present time many of the problems have been solved.

Physically, hydrofluoric acid differs appreciably from sulfuric acid. At strengths employed in alkylation, hydrofluoric acid is a volatile liquid at ordinary temperatures and hence must be stored in pressure vessels. It also possesses a certain degree of solubility in the hydrocarbons processed. Because of its volatility it readily lends itself to regeneration by distillation, thus making possible a very low consumption. This volatility also requires that rigid precautions must be constantly observed to prevent even minute leakage to the atmosphere for economic and safety reasons, since hydrofluoric acid is very toxic.

Hydrofluoric acid is charged to the alkylation unit in a practically pure state. No acid is rejected from the unit except by loss. A system acidity of 85 to 91% is maintained in the unit by the continuous regeneration of a split stream of the circulating acid. Such regeneration removes both water and acid tars. Acid consumption is very low, being less than 5% as compared to sulfuric acid consumption. Loss by system leakage, or because of shutdowns, accounts for the major part of this consumption, which will be materially reduced as operating problems are overcome.

Reaction temperatures range from 70° to 110° F. and are controlled by the use of cooling water, in the majority of cases.

Certain problems have been encountered in HF alkylation operations. There have been no difficulties with acid settling. However, because of the solubility of HF in hydrocarbons, two additional processing steps in handling the effluent hydrocarbons are required in this process, as compared to the sulfuric process.

First, a stripper is necessary to eliminate substantially all of the free dissolved HF and also the majority of the organic fluorides from the hydrocarbon reaction product. Free HF is removed by simple distillation and the fluorides are broken down to free HF by the elevated temperatures employed aided by the catalytic action of the materials used as tower packing. Some problems, notably loss of free HF due to faulty stripper operating technique, plugging of packing, and unsatisfactory fluoride removal, have been encountered from time to time. However, satisfactory progress is being made on these problems.

Secondly, stripper bottoms, even with what so far has been termed acceptable HF and fluoride removal, still contain more of these materials than is desirable to handle in the conventional distillation equipment of an alkylation unit because of their influence on corrosion and also on contamination of alkylation products. To correct this situation, a treater is provided to remove these residual fluorine compounds. Calcined bauxite is the most commonly used treating agent, but this has been found troublesome. Other treating agents are being tried but results so far are inconclusive.

The regeneration of spent HF has also imposed some operational problems. Removal of free HF by distillation from the acid tar bottoms has not been generally satisfactory. Also, these bottoms contain some fluorides, which result in a disposal problem. Reprocessing of this stock in the refinery is not considered advisable because of the fluorine content thereof.

Because of its fuming nature and toxic properties, it is necessary that escape of HF to the atmosphere be minimized. HF causes severe burns on living tissue and is particularly bad if inhaled. Ample precautions have been taken and safety measures have been followed, and it is gratifying to state that very few accidents have occurred. HF alkylation plant design includes provisions for flushing out all equipment containing the acid before such equipment is opened up for inspection and repair. When flushed out or dumped from the system as much acid as possible is collected in pressure storage vessels for reuse.

Residual acid or that which is vented is substantially neutralized by an alkaline solution allowing a minimum amount to be released to the atmosphere at some point where least nuisance will result. In addition many precautions are taken for protecting operating and repair personnel against accidental contact, as well as providing curative measures in case of exposure.

Hydrofluoric acid in the concentrations existent in the alkylation unit, excepting the regeneration equipment, is generally not corrosive to vessels and piping made of carbon steel of the type ordinarily used in refinery equipment. One of the most troublesome problems which has been experienced concerns plug valves in acid service. These valves, which require at least some dissimilarity in metal characteristics between plug and body to insure tightness, have been almost universally subject to severe stress corrosion cracking causing fracture when carbon steels are involved. Developments in progress for relieving this condition involve the use of nonferrous coatings of plug and body, such as monel, and there is promise of great improvement.

Another phase where improvement in material selection is under development is in the acid regenerating system, particularly the fractionating tower. More corrosion is encountered here than elsewhere due to the presence of water-diluted acid at elevated temperature. The use of various alloy linings, including silver, copper, and monel, have met with indifferent success. Of the three, monel appears to be preferable. It is not unlikely that a steel tower with sufficient corrosion allowance may be the best solution on a "take it and like it" basis.

It is essential that neither cast iron or glass be used in any service exposed to HF because of their silica content, which element is generally attacked by the acid. The necessary absence of gauge glasses has resulted in the use of some ingenious devices for determining liquid levels in vessels. Packing of pumps and protection against corrosion on instrumentation, when in contact with acid, requires special consideration.

Alkylation hydrocarbon feed stocks, particularly those containing the olefins, all contain sulfur contaminants such as hydrogen sulfide and mercaptans, the concentrations of which depend on the source of crude processed, the type of olefin being alkylated, and the degree of pretreatment, if any. These contaminants result in increased spending of the acid catalyst, particularly in the sulfuric acid process, and in the production of a non-acceptable corrosive alkylate. It is therefore a sound practice to caustic pretreat all feed stocks for substantially complete removal of these sulfur compounds.

All hydrocarbon feed stocks also contain some moisture which causes spending of the acid catalyst. In most sulfuric acid units water removal is not practiced since the water dilution is not a material spending factor at the acid replacement rates presently employed. On the other hand, substantially all HF alkylation units have equipment for maximum removal of moisture in feed stocks, since any water introduced must be subsequently removed in the acid regeneration step. Water removed by regeneration results in a loss of HF and materially affects the corrosion rate of this equipment.

Each olefin, namely propylene, the

butylenes, amylenes, cold acid isobutylene polymers, and codimers, commonly being charged to alkylation units, produces an aviation alkylate differing somewhat in quality and yield. Because of the variable effect of the significant reaction factors on these several olefins, the relative merits of these can only be generalized. Likewise a discussion of the reaction factors can, on this occasion, only cover general trends.

In sulfuric acid alkylation the order of preference, as far as quality of aviation alkylate produced from the olefins is concerned, is, generally speaking, as follows: butylenes, isobutylene polymer, codimer, amylenes, and propylene. In HF alkylation the order is not exactly the same, in that propylene produces better alkylate than do amylenes. It may be stated, in this connection, that acid consumption or acid regenerating requirements usually occur in inverse order to those given above.

Alkylates produced from the different olefins also differ in boiling range. Propylene alkylate has the lowest boiling range predominating in the C_7 and C_8 level. The boiling range for butylene alkylate is somewhat higher and is concentrated in the C_8 group. Amylene alkylate has the highest boiling points following the C_8 and C_9 hydrocarbons. These characteristic differences naturally tie in with octane quality, and also play an important part in final boiling range of aviation gasoline.

Yields of aviation alkylate on olefins consumed exhibit the same trend for both sulfuric acid and HF alkylation. For the simple olefins, propylene through amylenes, aviation alkylate yields fall off with increase in molecular weight of the olefin, ranging from approximately 170 to 145 vol. -%. Although the complex olefins, that is those obtained by previous polymerization, tend to follow the characteristics of their parent olefins, aviation alkylate yields therefrom may be somewhat lower because of the greater possibilities of side reactions.

The significant reaction variables include that well-known team of time and temperature, and also isobutane concentration, ratio of acid catalyst to hydrocarbons, and titratable acidity of the catalyst. In commercial operation these factors are more or less interlocked and hence optimum conditons for each can rarely be achieved, especially at the current high production rates.

Operating conditions are usually selected to give the best over-all result, which generally is defined as maximum 100-octane aviation gasoline production. This is usually accompanied by some degradation in alkylate quality. For instance, when increasing alkylate production in any given unit, reaction temperature as well as time are usually adversely affected, and if this unit utilizes HF catalyst, regenerating equipment may be overloaded, which adversely affects the acid strength factor. Also, desirable increases in isobutane concentration and in acid-hydrocarbon ratio result in depreciation of time factor effect.

As in many chemical reactions, increase in time factor gives improved results, particularly as regards quality of alkylate. For practical operation there is a minimum time limit below which unsatisfactory results are obtained. Also, increases in time factor above some upper limit will result in only minute, and hence uneconomical, improvement. Alkylation units have been generally designed to approach the upper limit, thus permitting them to materially increase plant throughput as increased olefin supply was made available.

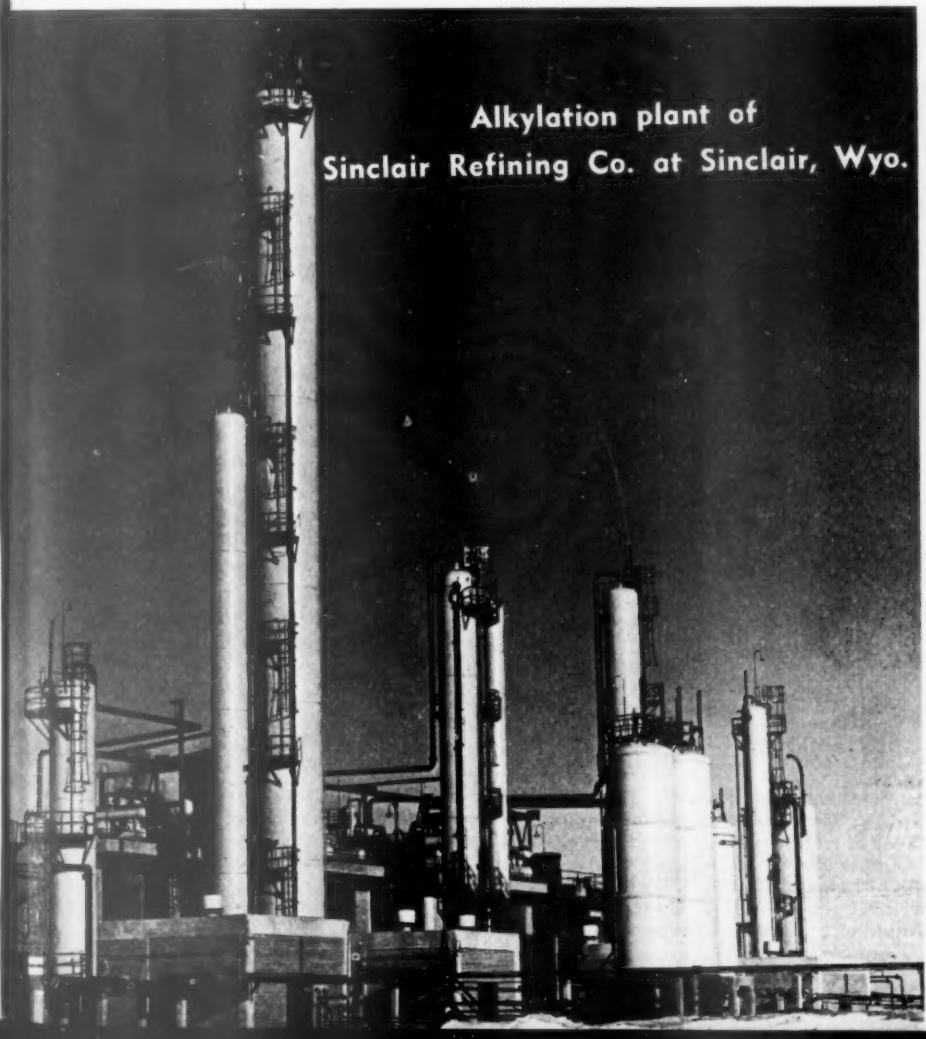
It has been previously indicated that the optimum temperature plane for sulfuric acid alkylation is materially lower than for HF alkylation. The general rule applies that alkylate quality improves with reduction in temperature within certain limits, but the relationship of rich octane rating quality does not necessarily behave like that for lean octane rating quality.

The alkylation reaction is promoted by high isobutane concentrations, which has a beneficial effect on quality. Consideration of isobutane concentration deals with ratio to diluents such as propane, butane, and pentane, as well as with ratio to olefins.

Acid strength plays an important part in the quality of alkylate produced. When using sulfuric acid, alkylate quality is a direct function of acid strength employed. Catalyst consumption is also in direct proportion to this factor. Obviously, for economic and supply reasons, the higher strengths cannot be commercially employed as the fresh acid make-up rate becomes excessive. In the HF process there is evidence that an optimum strength favors the rich octane rating but variations therefrom have little effect on lean rating.

With either acid catalyst improved results are obtained with increasing ratios of acid to hydrocarbons, or percentage acid in the reaction mixture. About 50% acid is usually considered a minimum. For sulfuric acid there appears to be a ceiling above which a tendency is exhibited to form tighter emulsions in the reaction zone, making acid settling quite difficult. No ceiling is as yet known for HF. This acid is more fluid and hence does not have the emulsifying characteristics of sulfuric acid.

According to reports, there may be a possibility of producing a super aviation fuel in which alkylate may play a part even more important than it does in the current grade. When and if this materializes, the oil industry will be prepared to meet the requirements in the same record manner that has signalized its accomplishment in supplying the current requirements.



Alkylation plant of Sinclair Refining Co. at Sinclair, Wyo.

Four Neighboring Refiners Install Joint Catalytic Cracking Unit

Group of Pennsylvania Independents Joined Hands 15 Years Ago to Erect Thermal Cracker; Now Operate 4500 b/d Fluid Catalytic Plant to Produce Aviation Base Stock

By Paul Truesdell and W. E. Lemen

THE 100-octane gasoline plant in the Pennzoil refinery at Oil City, Pa., represents extension into the war effort of a joint oil-cracking enterprise which was set up by four neighboring refiners almost 15 years ago. The companies are Pennzoil, Quaker State Oil Refining, Wolf's Head Oil Refining and Continental Refining.

The four joined in 1931 to install a 2500 b/d single-coil, UOP thermal cracking unit for their common use. It was named Dubbs No. 3. It replaced Dubbs Nos. 1 and 2 of 1000 b/d capacity each, which had been installed by Pennzoil alone in 1927.

Dubbs No. 3 was the first joint cracking plant in the history of the oil industry and the arrangement entered into by its owners was unique. They did not form a corporation or a partnership. They were then and still are keen competitors, yet they have gone along to this day amicably and successfully, their obligations defined and their rights safeguarded by nothing more than a mutual understanding set forth in a simple contract. This arrangement gave the co-owners confidence to venture together into the war production program.

The No. 3 unit was built on Pennzoil land and is operated by that company. Each participating refiner supplies his proportionate share of cracking stock, bears his share of the costs and takes his share of the products. Pennzoil furnishes more than half of the charging stock.

Cracking of Pennsylvania oils proved so satisfactory that Pennzoil alone, in 1932, installed a UOP thermal unit for reforming and once-through cracking, which was christened Dubbs No. 4. This is not a part of the common cracking plant.

In 1938, the four-company cracking unit was converted to two-coil operation by the addition of a light oil heater and its capacity was increased to 4500 b/d. The following year the associated refiners installed a 200 b/d UOP catalytic polymerization unit to polymerize the olefins in the overhead condensate from the thermal cracking unit stabilizer, thus increasing the over-all yield of gasoline from the crude and improving its octane rating.

At about that time, Pennzoil management had begun to explore with Universal Oil Products Co., the economic feasibility of a Fluid catalytic cracking unit as a means of improving the quality of their gasoline. The imminent threat of war to the U. S. brought the matter to a head. A few weeks before Pearl Harbor, W. S. Zehrung, president of Pennzoil, with the approval of the other refiners, decided that the time had come to install a common catalytic cracking unit. The four refiners were ready to pay for it with their own money. Direct responsibility for seeing the construction program through, not only for the "cat cracker" but other installations in the joint 100-octane gasoline plant, devolved upon D. W. Grant, vice president of Pennzoil.

The primary objective was to put the refinery into the war effort most effectively as a producer of aviation gasoline; the secondary purpose was to assure the companies of the ability to meet any high octane standards that might prevail in the postwar gasoline market.

The present 100-octane gasoline plant goes far beyond the original plans. It comprises three elements that make up a complete aviation gasoline refinery; namely, a single-stage Fluid catalytic cracker of 4500 b/d capacity, a gas concentration unit, and a UOP HF alkylation unit designed to produce 740 b/d of alkylate.

The catalytic cracking unit, with auxiliaries and alterations to other process units, cost the co-owners more than $2,000,000. The gas concentration and alkylation units, with auxiliaries, which were financed by the Defense Plant Corp., cost well over $3,000,000 more. These facilities are operated by Pennzoil under contract with the government.

These combined facilities are turning out today 50 per cent more 100-octane gasoline than they were originally expected to produce.

These men represent the four refining companies which joined together in the operation of a Fluid catalytic cracker after 15 years of successful joint operation of a common thermal plant. TOP ROW (L. to R.)—W. S. Zehrung, president, the Pennzoil Co.; W. R. Reitz, secretary, Quaker State Oil Refining Corp.; A. W. Scott, president and secretary, Wolf's Head Oil Refining Co.; A. B. Weingard, president, Continental Refining Co. BOTTOM ROW (L. to R.)—J. C. Grosser, supt., Plant No. 2, Pennzoil; D. W. Grant, vice president, Pennzoil.

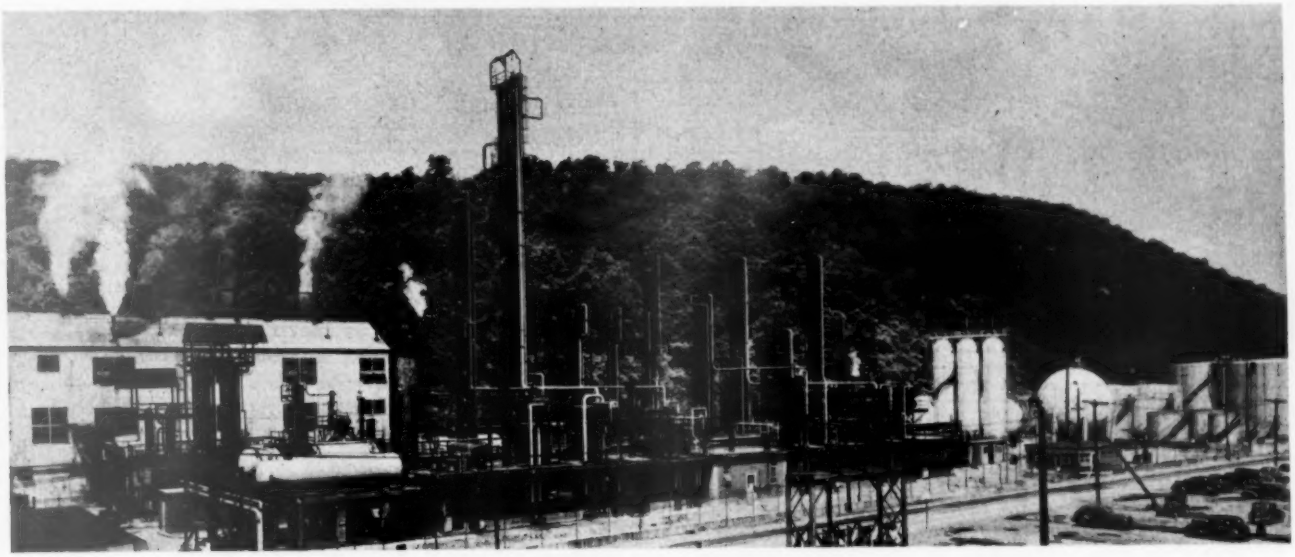
Main Pennzoil Refinery

At the time the joint aviation gasoline plant was projected, Pennzoil was producing from Pennsylvania crude at its No. 1 plant at Rouseville, 3 miles north of Oil City, the following products:

S. R. gasoline (360°F. e.p., 52 octane, 6 lb. RVP.)
Kerosine (w.w.) (360°F. b.p., 45° API gravity.)
Light gas oil (400-700°F b.p., 40° API gravity.)
Wax distillate.
Steam cylinder stock.

The straight-run gasoline was reformed in Dubbs 4, the kerosine was sold or

Both authors are associated with Universal Oil Products Co., Chicago.



Pennzoil Plant No. 3, where four neighboring refineries are co-operating in the production of aviation gasoline. Showing the boiler plant (left), HF alkylation unit, gas concentration unit, and pressure and atmospheric storage

cracked, as conditions required, and most of the gas oil went to the common cracking unit. The wax distillate and cylinder stock were processed in the complete modern lube plant into high quality motor oil. Today, a methyl-ethyl-ketone solvent dewaxing plant is under construction in Plant 1 as a further addition to the lubricating oil plant.

Ground was broken for the aviation gasoline plant in October, 1942. It was a combination conversion and new construction job. Universal was the designer and licensor of the processes; Arthur G. McKee & Co. was the engineering contractor. Both companies had collaborated with Pennzoil in installing the earlier UOP thermal cracking units and in making all subsequent additions and changes.

The new facilities were placed on two separate pieces of land stretching along Pennsylvania State Highway No. 8, which follows the course of Oil Creek northward out of Oil City. They are known as Plants 2 and 3.

The new catalytic cracker was placed in Plant 2, where Dubbs No. 3, Dubbs No. 4 and the polymerization unit are located. By an interesting coincidence, the "cat cracker" was built on the exact site of old Dubbs 1 and 2. Plant 2 is about 2 miles south of No. 1. The Quaker State refinery, known as the "Independent Plant," adjoins it on the south and the plant of the Continental Refining Co. bounds it on the north. The Wolf's Head refinery is located at Reno, about 6 miles away.

Plant 3, also called the D.P.C. plant, is a third of a mile north of Plant 2 on a 5-acre tract which was purchased by Pennzoil for D.P.C. It contains the gas concentration unit, the HF alkylation unit, and the necessary utilities, including a new cooling tower, a new boiler plant and complete facilities for inhibiting, ethylizing, blending, storing and shipping aviation gasoline. Plant 3 was financed and is owned by Defense Plant Corporation.

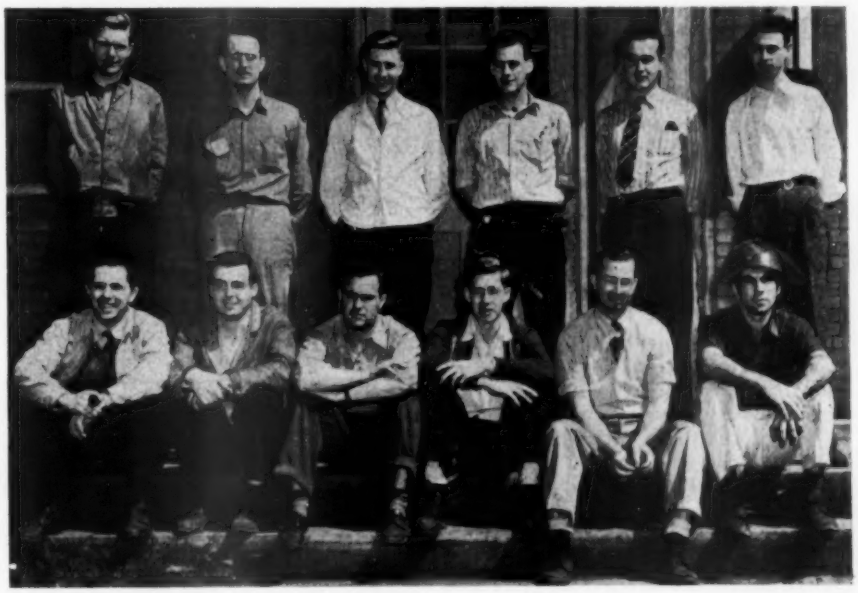
Thermal Cracker Converted

Dubbs No. 3 was the starting point in the war conversion program, although in 1942, before this work began, the four refiners had made a contribution to the aviation gasoline supply by converting the polymerization unit from motor polymer to codimer production.

Dubbs No. 3 is the first UOP thermal cracking unit ever to be tied into a catalytic cracking operation. Here is the way it was done.

The fractionator, which had almost reached the retirement stage for high pressure operation, was found to be of suitable size to serve, with minor changes, as the fractionator for the catalytic cracker. So it was moved to the proper location and placed in a service which requires an operating pressure of only 5 lbs. A new tower, designed for 90 lbs. pressure, was installed on the thermal cracker.

It was evident that under the new scheme, the thermal cracker would lose its old job, because the gas oil and kero-



To these operating personnel goes much of the credit for increasing the output of the jointly managed refinery 50% above design capacity. With J. C. Grosser, supt. of Pennzoil Plant No. 2, they are responsible for the operation of Plants 2 and 3. TOP ROW (L. to R.)—L. R. Brandon, U.O.P.; Jack Stevens, U.O.P.; W. E. Lemen, U.O.P.; Bruce Rooker; Jack Beighley; Kenneth Smith. BOTTOM ROW (L. to R.)—Ralph Crowther; Alan Hoffman; Clayton Fontaine; Harry Fennick; Raymond Dardes; Bob Swoope, U.O.P.

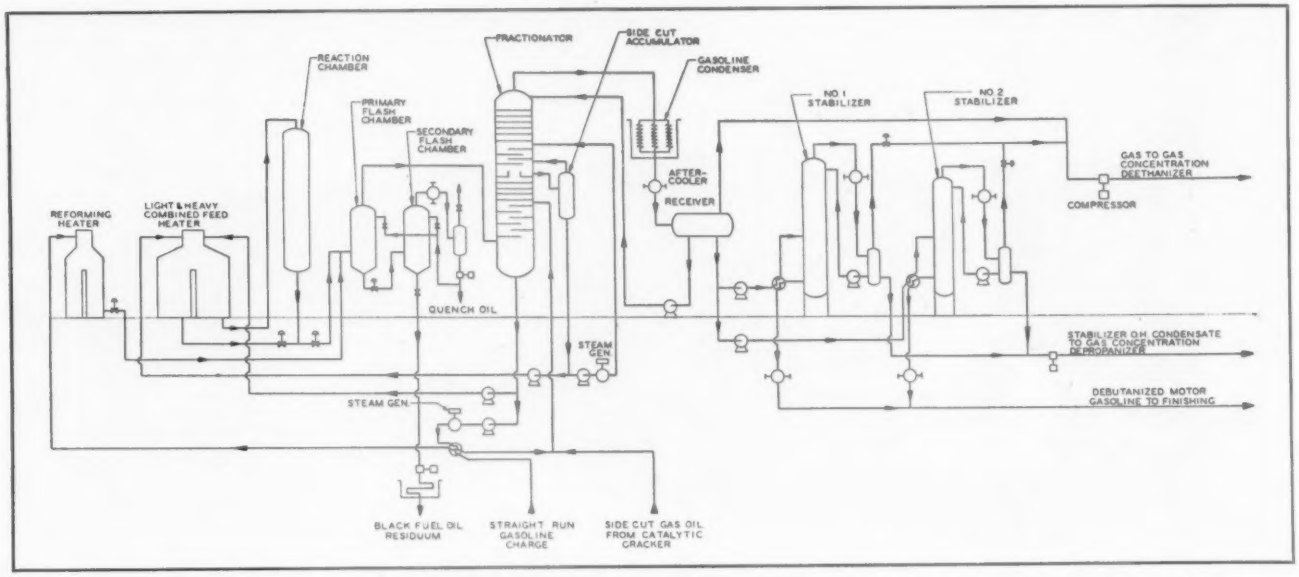


Fig. 1—Flow chart for the Dubbs No. 3 unit, which was redesigned for combined gas oil cracking and reforming

sine formerly charged to it would go to the catalytic cracker instead. The only material available for the thermal cracking would be catalytic cycle stock, amounting to 1500-2000 b/d, and straight-run gasoline.

It was found that the original two-cell heavy oil heater of the thermal cracker, a 45,000,000 Btu/hr. furnace, had sufficient capacity to handle all the catalytic cycle stock. Two-coil operation could be carried out by merely separating the coils, using one side for light and one for heavy oil. This was done, giving the unit a capacity of about 2500 b/d and effecting a substantial economy.

Through this arrangement, the light oil heater, a 30,000,000 Btu/hr. furnace, was released for use, without being moved from its original location, as a heater for the feed to the catalytic cracker.

A U.O.P. center wall updraft reforming heater of 3500 b/d capacity was added, so that the reforming of straight-run gasoline and cracking of cycle stock could be done in a single unit, thereby economizing on manpower and operating costs.

The remodeling of Dubbs 3 was carried on in such a manner that its operation was interrupted for only two months.

In its new role today this thermal unit is cracking about 1600 b/d of cycle stock and 2500 b/d of straight-run gasoline. The former is produced in the catalytic cracking unit. The gasoline comes from the refineries of the four companies.

The cycle stock is pumped directly from the fractionator of the "cat cracker" into the thermal cracker fractionator, which operates at a top temperature of 370°F., bottom temperature of 615°F., and 93 lbs. pressure. Heavy combined feed from the bottom of the fractionator is charged to the heavy oil side of the heater and light combined feed, as a side cut from the fractionator, is charged to the light oil coil.

Heat is recovered from the fractionating column of the thermal unit by circulation of side-cut and bottoms through steam-generating heat exchangers, which together produce 18,000 lbs./hr. of 125-lb. steam. This method of heat recovery was installed as the economical way to relieve the load on an old and overtaxed boiler plant.

The heavy oil stream leaves the heater coil at a transfer temperature of 915° F and goes into the top of the reaction chamber, which operates at 375 lbs. pressure. The light oil stream leaves the coil at 945° F. and joins the heavy oil stream at the reaction chamber outlet, ahead of the pressure control valve.

Vapors from the reformer, leaving the heater at transfer temperature of 975-1000° F. and a pressure of 500 lbs., are quenched with light oil to a temperature of 800° F., passing through a pressure control valve and joining the other streams at the primary flash chamber inlet.

Overhead from the primary flash chamber enters the fractionator at a point below the inlet of the cycle stock. Primary flash chamber bottoms go to a secondary flash chamber operating at 30 lbs. pressure and 525° F. temperature. Overhead from the secondary flash chamber is used as transfer quench and flash chamber reflux. Bottoms from the secondary flash chamber, black fuel oil of 10° F. API gravity, represent about 10% of the gasoline-cycle stock charge. Table 1 shows the feed charge and products recovered in Dubbs No. 3.

Overhead from the fractionator goes to a receiver where liquid and gas are separated. A 2-cycle, 200 h. p. gas-engine driven compressor compresses the gases from 90 to 225 lbs., and delivers them to the deethanizer of the gas concentration system for the recovery of C_3 and heavier hydrocarbons.

Unstabilized gasoline from the receiver goes to a pair of stabilizers operating in parallel as a debutanizer. The overhead condensate is charged to the depropanizer of the gas concentration system. The bottoms are debutanized motor gasoline fractions.

The butylenes and isobutane recovered make up a part of the charge to alkylation; thus, the thermal unit has a substantial part in the production of aviation gasoline, as well as in converting cycle stock and straight-run into motor gasoline.

Catalytic naphtha from the bottom of the rerun column of the gas concentration system, and motor polymer when available, are blended with the thermally cracked and reformed motor gasoline. Its vapor pressure is raised to specifications by the addition of normal butane recovered from the thermal and catalytic BB fractions and separated in the debutanizer of the alkylation unit.

Dubbs No. 4 is now employed by Pennzoil alone as a standby for motor fuel production, being used to crack

TABLE 1

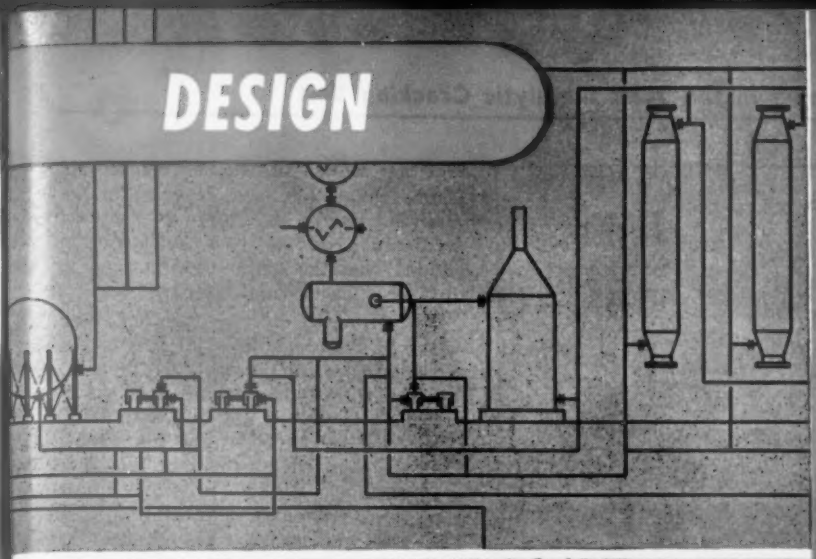
Charge Stock and Yields at Dubbs No. 3

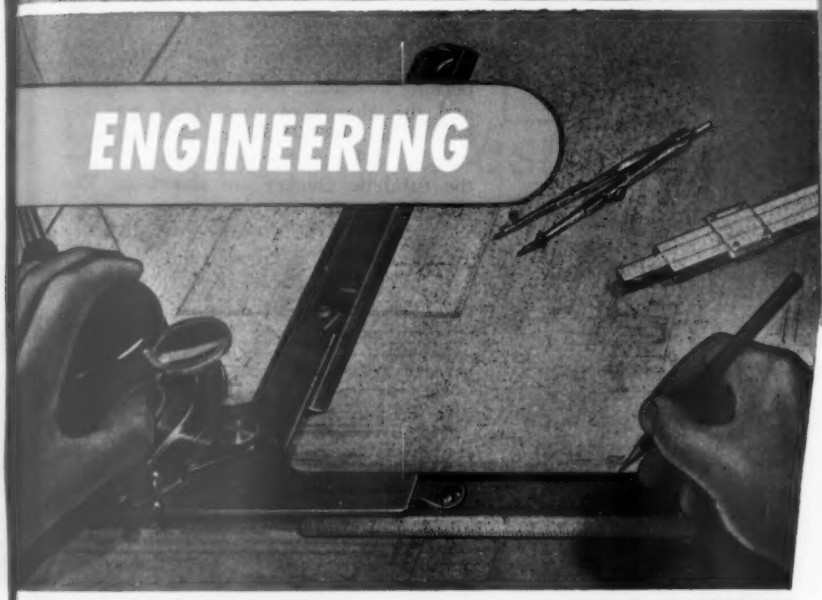
FEED TO DUBBS NO. 3

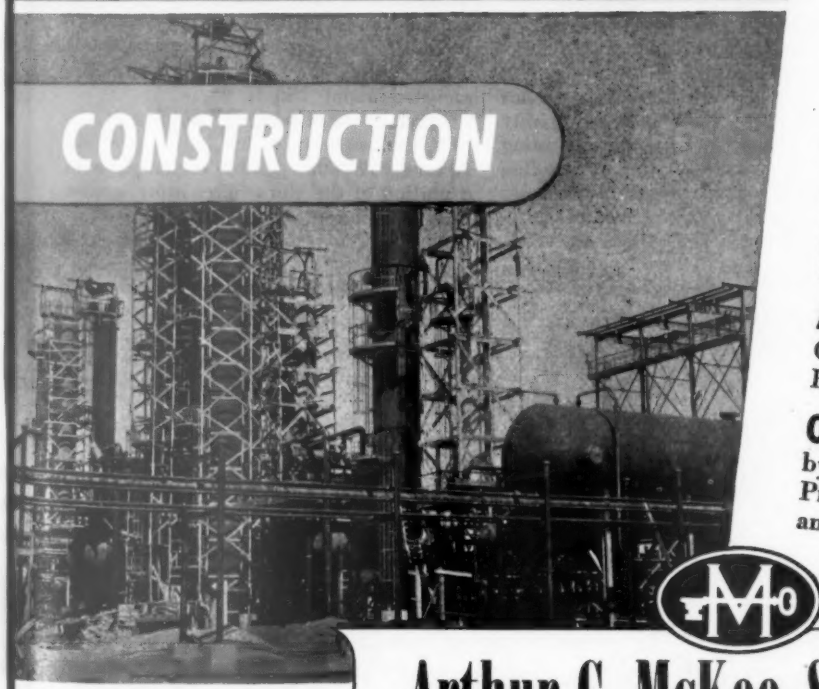
Straight Run Gasoline	Catalytic Cycle Stock
360° F. end point	36-37° API gravity
52 octane rating	400° F. I.B.P.
	650° F. end point

PRODUCTS FROM DUBBS NO. 3

	Vol.—%	b/d
Motor Gasoline Fractions	72-77	2900-3100
400° F. end point		
64-65 octane rating		
5-6 lb. RVP		
Butylenes	5	200
Isobutane	1.5	60
Bottoms	10	410
Gas	9-12	...







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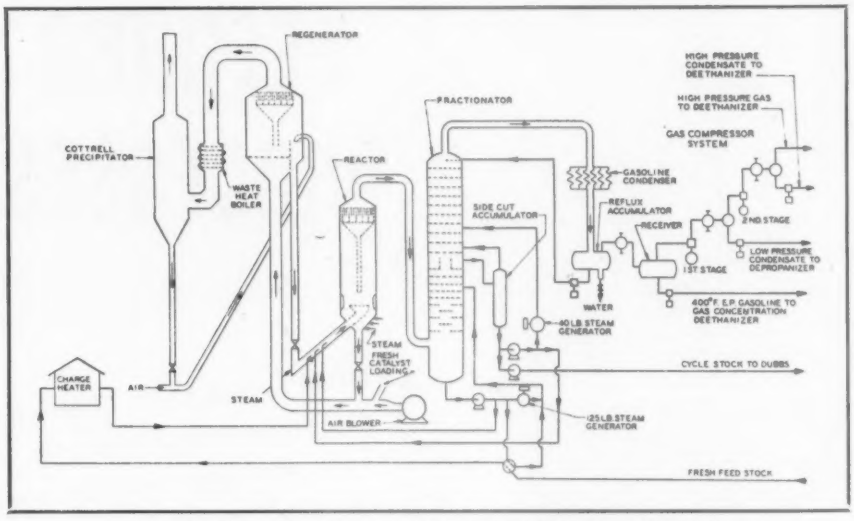


Fig. 2—Flow chart for the Fluid Catalytic Cracking Unit

excess gas oil or kerosine or to reform excess straight-run gasoline.

The catalytic polymerization unit, which was robbed of its normal feed in the new arrangement, was modified so that it could process the gas concentration depropanizer overhead to produce motor polymer. This was accomplished by combining the depropanizer overhead and the normal butane stream from the alkylation unit debutanizer in the poly unit feed drum, providing a liquid feed which can be processed without extensive alterations to the existing equipment. Normal butane thus recovered is combined with the debutanized motor gasoline components along with the polymer.

Catalytic Cracking Unit

The Fluid catalytic cracker produces the aviation gasoline base stock, most of the isopentane, and the greater part of the isobutane and butylenes which go to make up alkylate for 100-octane gasoline. In one method of operation, the cat cracker has produced from a virgin feed of 4300 b/d these vital products:

	Bbls.	Vol.-%
Depentanized base stock (330° E.P.)	875	20.3
C_5 fraction	460	10.7
Butylenes	325	7.5
Isobutane	460	10.7

The 4500 b/d design capacity of the catalytic cracker was based on a charge composed of 3900 bbls. of gas oil of 39-40° API gravity and 600 bbls. of kerosine of 45° API gravity. It was expected that the gas oil and kerosine produced in the Pennzoil plant and in those of the co-owners would be sufficient to supply the feed stocks in that ratio and in the quantities needed. Owing to shortage of Pennsylvania crude, that condition has not prevailed. Consequently, it has been necessary to purchase gas oil from other sources.

Under these conditions the catalytic cracking unit has demonstrated its versatility. When sufficient fresh feed stock was available, the unit has cracked as much as 5000 b/d. It has run on charges ranging from straight gas oil to mixtures containing up to 30% kerosine, taking them in stride. Even Illinois gas oil as low as 33° API gravity has been cracked without difficulty and with no serious effect on yields.

Operating conditions have been varied as much as charging stocks to meet special requirements. For instance, since isobutane became available from outside sources, the reactor temperature has been progressively increased to 950° F. in order to produce at the same time the maximum amount of butylene for alkylation and a base stock suitable for aviation blending without treatment other than a caustic wash.

During periods when output of 100-octane gasoline is limited by shortage of alkylate, the over-all production has been increased by improving the quality of the base stock in a partial retreating operation in which 400° e.p. gasoline from the receiver is returned to the reactor along with the fresh feed.

Sidecut or cycle stock from the fractionator, which usually is cracked in Dubbs No. 3, has been recycled to the catalytic reactor in order to maintain maximum yields of base stock during periods when the supply of virgin charge stock was insufficient.

For instance, during the first two weeks in February, 600-700 b/d of recycle gasoline was charged to the unit, together with 4000-4200 bbls. of virgin gas oil, in order to improve base stock quality. Late in February the operation was changed. Instead of recycling raw gasoline, 750-850 b/d of sidecut cycle stock was charged to the unit with 4300-4400 bbls. of fresh gas oil, in order to increase the overall production of aviation gasoline.

When sufficient fresh feed stock again became available, recycling was stopped and the charge of fresh feed was increased to 4800-5000 b/d. Normal feed stocks and quality of product for the catalytic cracker are shown in Table 2.

Yields from the operation when processing 3800 b/d of virgin gas oil and 700 b/d of sidecut cycle stock (calculated on fresh feed input basis) were:

Debutanized base stock	36.4 Vol.-%
Naphtha	7.1 Vol.-%
Light gas oil (cycle stock)	23.6 Vol.-%
Total C_4 fraction	26.4 Vol.-%
C_3 and lighter gases	12.8 Wt.-%
Coke	5.9 Wt.-%

Had this catalytic cracker been less flexible, production of aviation gasoline would have suffered severely.

The reactor of the Fluid catalytic cracking unit is a 13 ft. by 54 ft. vessel mounted vertically near the ground. Its normal operating pressure is about 10 pounds. The regenerator, operating at 1 lb. pressure, is a 20 ft. by 32.5 ft. vessel elevated about 150 ft.

Fresh oil feed passes through a G-fin heat exchanger in which its temperature is raised to 300° F. by exchange with a portion of the slurry circulating stream from the bottom of the fractionator, and thence to the heater in which the tem-

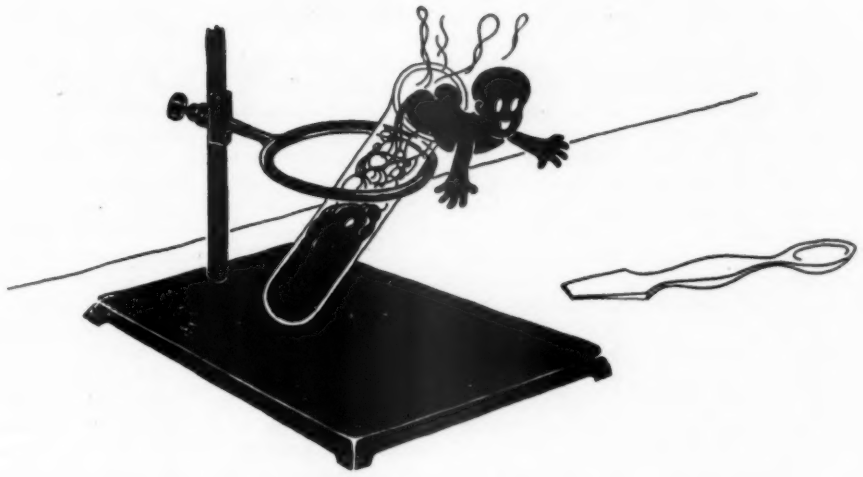
TABLE 2—Quality of Charge Stock and Products for the Fluid Cracking Unit

Normal Feed Stock and Quality of Products

	Fresh Feed	Debutanized Base Stock	Heavy Naphtha	Light Gas Oil
Type: Gas Oil				
Gravity	39.0	66.0	37.4	37.5
A.S.T.M. Dist.				
I.B.P., °F.	387	99	338	412
10%	492	116	349	485
50%	575	155	360	530
90%	658	284	370	600
E.P.	705	327	417	665
Sulfur, Wt.—%	0.01			
Reid V.P.	9.1			
Octane number				
AFD—1C clear		80.8		
AFD—1C + 4.6 cc TEL		91.1		
AFD—3C + 4.6 cc TEL		5 + 0.37		

Composition C_4 Fraction Liquid

	Vol.—%
Isobutylene	12
Normal butylene	24
Isobutane	53
Normal butane	11



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HYDROGENATION	*HYDROFORMING*	*U. O. P. CATALYSTS*
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perature is raised to 750° F.

The partially vaporized charge enters the catalyst section at the line through which catalyst at a temperature of 1050-1100° F. is circulated to the reactor. This line is the injector. About 1300 lbs./hr. of steam is introduced at the injector, to assist the mixing of catalyst and oil. The catalyst from the regenerator supplies the greater part of the heat required for vaporizing and cracking the charging stock. Current operation is carried out with a reactor temperature of 950° F.

The reactor temperature is largely a function of the regenerator temperature, the catalyst circulation rate, and the preheat on the oil feed to the reactor. A constant temperature is maintained in the reactor by minor adjustments of the catalyst circulation rate and preheat on the fresh feed, while the regenerator temperature is allowed to vary within 50° F. range.

With a regenerator temperature of approximately 1100° F., the catalyst circulation rate is about 7 tons per minute, which maintains a ratio of 15 pounds of catalyst per pound of oil.

Hydrocarbon vapors, steam, and some entrained catalyst pass upward through a disengaging space into a multiclone separator mounted in the top of the reactor. The multiclone is a series of small cyclone dust separators arranged to operate in parallel.

Catalyst knocked out by centrifugal action in the multiclone is returned to the dense phase through a collection hopper and dip leg. Hydrocarbon vapors carrying only a small amount of catalyst pass overhead from the multiclone to the fractionator, entering at a point just above the liquid level at the bottom.

The fractionator is an 11 ft. by 65 ft. tower containing 12 trays above a center well, and 2 trays, 2 perforated plates, and 7 perforated disc and donut pans below. Heat is recovered from the lower section by circulation of fractionator bottoms through a steam generating heat exchanger which produces 7000 lbs./hr. at 125 lbs. pressure.

Oil leaving the steam generator at 400° F. is returned to the fractionator at the upper perforated tray, along with the bottoms stream from the fresh feed exchanger. This circulation of bottoms not only supplies the necessary cooling, but also provides the liquid wash for scrubbing entrained catalyst from the rising vapors.

The concentration of catalyst in the bottoms or slurry is maintained between 0.5 and 1.0 lb./gal. by continuously returning column bottoms to the reactor via the injector.

Mid-column cooling is provided by circulating sidecut drawn from the center well into an accumulator through a low pressure steam generating heat exchanger which produces about 3000 lbs. of 40-lb. steam per hour. This stream leaving the exchanger at 300° F. is returned to the column 3 trays above the center well. The sidecut or cycle stock is pumped directly to the thermal cracking unit.

The fractionator operates at a pressure of 5 lbs. The bottom temperature is held at 550-575° F. and the top temperature is maintained at 225° F. by returning gasoline from a reflux accumulator to the top of the column. Water from the condensation of the steam injected into the reactor is withdrawn continuously from a leg on the reflux accumulator.

Overflow from the accumulator passes through a subcooler into a receiver from which the 400° F. e.p. unstabilized gasoline is pumped to the gas concentration unit, while the gas goes to the compressor suction drum and thence to the first stage of a 600 h.p. 2-stage compressor.

Discharge from the first stage at 50 lbs. pressure passes through a cooler into a receiver. Low pressure condensate is pumped to the gas concentration depropanizer. Fifty-pound gas passes to the second stage of the compressor in which the pressure is raised to 225 lbs. The second stage discharge passes through a cooler into a high pressure receiver from which the gas and high pressure condensate go to the gas concentration deethanizer.

Spent catalyst leaves the bottom of the reactor at 900-950° F., passes through a slide control valve and drops into the line through which air for regeneration is introduced. The catalyst is picked up by this air stream and carried upward into the regenerator through the regeneator riser, inside diameter of which is 36 in.

The temperature in the regenerator is 1050-1100° F. This temperature is maintained by burning coke deposited on the catalyst during cracking. Coke on the spent catalyst amounts to 1.0 to 1.5% by weight. This is reduced to 0.5 to 1.0% in the regenerator.

The total quantity of coke burned in the regenerator is 30-35 tons per day. Regeneration air is supplied by a turboblower unit capable of delivering 11,600 std. cu. ft. at a discharge pressure of 18 lbs. The air rate is controlled by adjusting a butterfly valve in the blower discharge to maintain an oxygen concentration of 2-3% in the combustion gases leaving the generator.

Combustion gases from the regenerator pass overhead at 1000-1050° F., through a waste heat boiler in which sufficient heat is recovered to generate 3000 lbs. of 40-lb. steam per hour. The partially cooled gases are further cooled to 375-400° F. by the injection of water into the duct below the waste heat boiler.

The total inventory of catalyst in the unit is approximately 125 tons, of which 35 tons are above the grid in the reactor and 55 tons above the regenerator grid. The catalyst replacement on this unit amounts to approximately 1 ton per day.

The catalyst used at present is a synthetic silica-alumina having an average particle size of about 200 mesh. Natural or Filtrol catalyst was used in a 12-day trial run when the unit was first put into operation.

In order to minimize the use of alloy steel the vessels and lines in service over 1000° F. are internally insulated with 4 in. of soft insulating block and 3 in. of refractory tile.

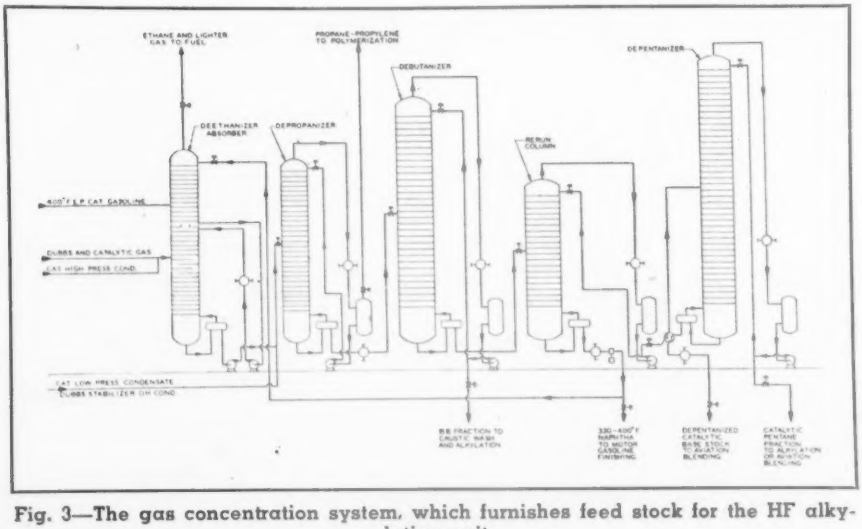

ETHANE AND LIGHTER GAS TO FUEL
PROPANE-PROPYLENE TO POLYMERIZATION
DEBUTANIZER
DEPENTANIZER
DEETHANIZER ABSORBER
DEPROPANIZER
REBUN COLUMN
400° F.E.P. CAT. GASOLINE
BUBBS AND CATALYTIC GAS
CAT. HIGH PRESS. COND.
CAT. LOW PRESS. CONDENSATE
BUBBS STABILIZER OH COND.
B.B. FRACTION TO CAUSTIC WASH AND ALKYLATION
330-400° F. NAPHTHA TO MOTOR GASOLINE FINISHING
DEPENTANIZED CATALYTIC BASE STOCK TO AVIATION BLENDING
CATALYTIC PENTANE FRACTION TO ALKYLATION OR AVIATION BLENDING

Fig. 3—The gas concentration system, which furnishes feed stock for the HF alkylation unit

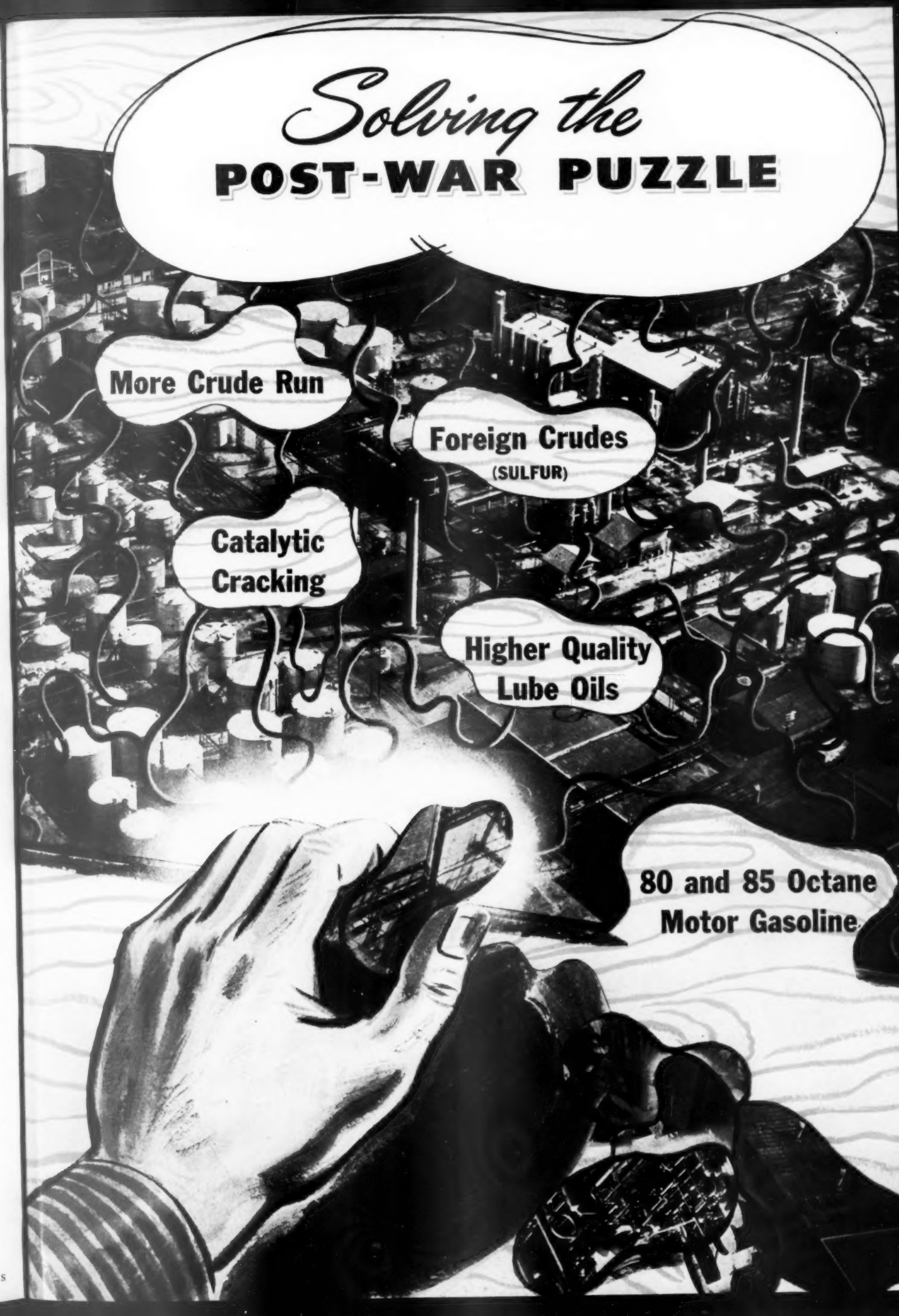
Gas Concentration Unit

The function of this unit is to classify and separate the various hydrocarbon fractions contained in the catalytic gasoline, the compressor condensates, the stabilizer overhead condensate, and the high pressure gases, and to distribute them to the best advantage. This involves a number of specific jobs, namely:

1—To recover C_3 and heavier hydrocarbons from the cracking plant gases.

2—To segregate the C_3 fraction for feed to the alkylation or polymerization unit.

(*Continued on p. R-482*)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MODERN and complete in every sense, the British American Oil Co.'s new refinery at Clarkson, Ontario, is a model of efficiency, designed and laid out so that each unit dovetails into the over-all process plan.

The refinery, built at a cost of $9,000,000 to supply fuels and lubricants for Canada's wartime aviation training program, was completed last June and is now in full operation. The entire cost of the project was borne by British American.

Constructed entirely from the ground up on a virgin site, there was no old plant to modernize or revamp, no existing equipment to take into account and fit into the picture.

As a result, British-American can boast of operating the first completely integrated refinery in Canada, with every piece of equipment laid out for maximum convenience and efficiency.

Clarkson is located on the northern shore of Lake Ontario, about 20 miles southwest of Toronto and midway between Toronto and Hamilton. Admittedly, the site is one of the finest for a refinery. The ground is level, with a gradual slope toward the lake. No watershed drains into the area so that drainage is not a problem. The top few feet of soil are clayish, excellent for tank dikes; below that is a strata of shale, making a solid foundation for heavy towers and other equipment. Lake Ontario provides convenient shipping facilities and an ample water supply.

The entire refinery area covers a total of approximately 300 acres immediately adjoining the lake, but only about half of the space is now occupied by equipment and storage tanks. The rest is available for future expansion, with the present units being placed so that they can be expanded without disrupting the unified layout of the plant.

Clarkson's Facilities

Facilities at the Clarkson refinery, as shown in the over-all flow chart for the plant, Fig. 1, include the following major units:

1) Atmospheric Distillation Tower, for topping the raw crude and reducing it to 35% bottoms, in addition to splitting it into various lighter fractions: straight-run overhead distillate, naphtha, mineral spirits, kerosine, gas oil.

2) Aviation Gasoline Stabilizing Tower, which removes the C_4 and lighter hydrocarbons from the straight-run overhead distillate produced in the initial topping operations, resulting in a 7# RVP aviation gasoline base stock.

3) Vacuum Distillation Towers (primary and secondary), which charge the bottoms from the atmospheric tower and split them into secondary gas oil, four lubricating oil fractions, and asphalt.

4) Lubricating Oil Plant (including

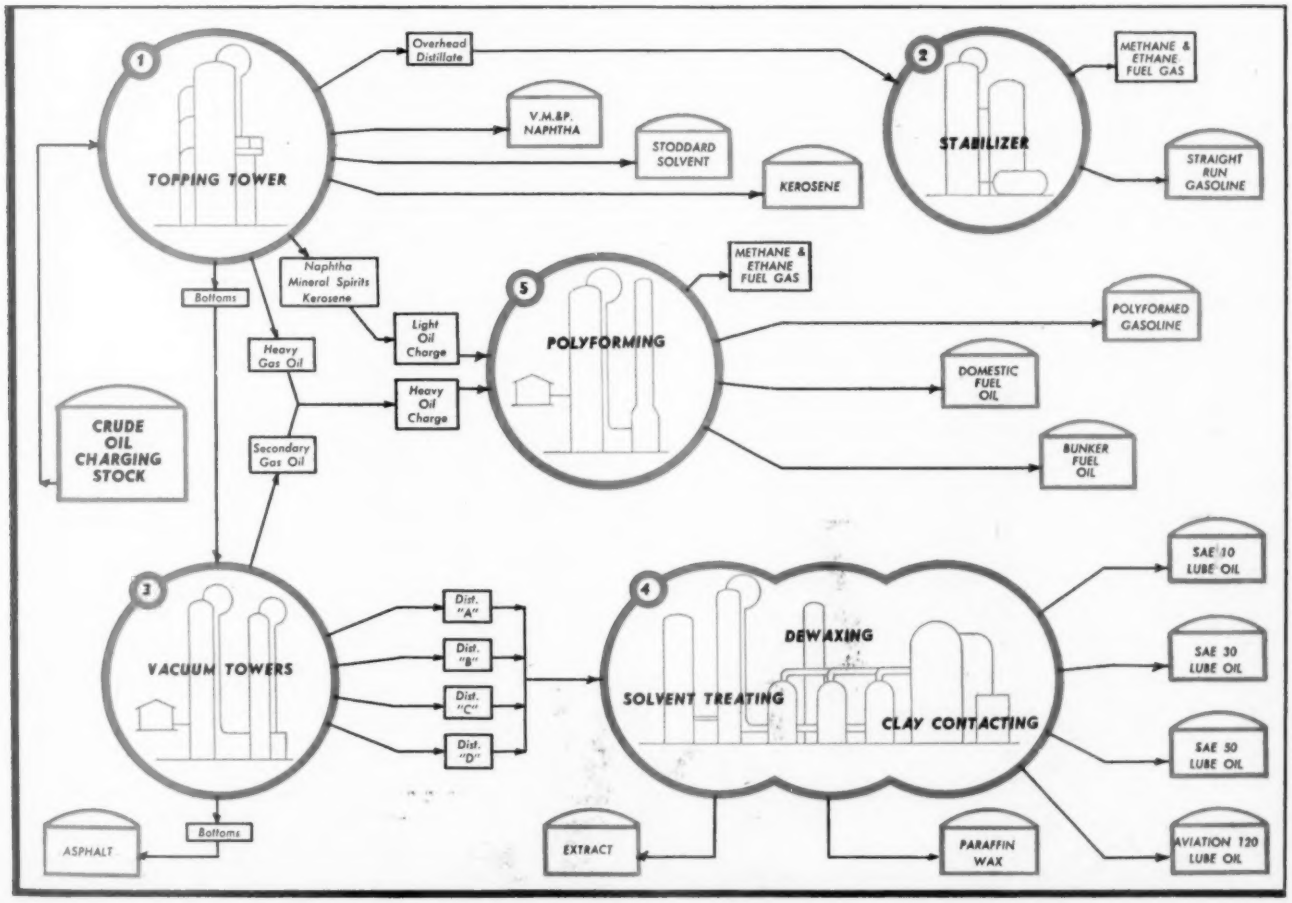


Fig. 1—Every unit at Clarkson fits into the over-all process plan, as shown in this integrated flow chart for the refinery

Furfural solvent extraction, MEK solvent dewaxing and contact filtration), which processes in sequence the four cuts from the vacuum distillation towers into finished aviation and motor oils. The Furfural and MEK plants are the first to be erected in Canada.

5) Polyform Unit, which charges two streams—(1) heavy (secondary gas oil from the vacuum distillation tower and heavy gas oil from the topping tower) and (2) light (excess straight-run naphtha, mineral spirits and kerosine from the topping tower), making either aviation gasoline (87 octane with addition of lead) or motor gasoline, as well as domestic furnace and bunker fuel oil.

In addition, a plant is now under construction for the processing of industrial or paving grades of asphalt, using the bottoms from the primary vacuum distillation tower as base stocks.

Space has also been provided in the layout of the Clarkson units for a blending and compounding plant which will enable the refinery to turn out a complete line of finished motor and industrial lubricants. At present, however, all blending and compounding are being handled at B-A's refinery in Toronto.

Fig. 2, the plot plan of the refinery, shows the integrated layout of all these units and the expansion space that has been provided.

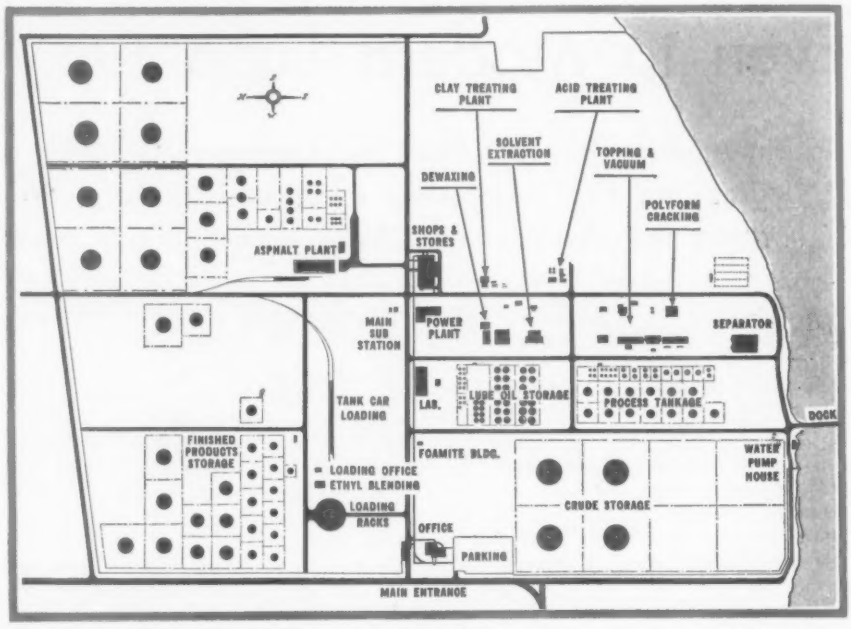


Fig. 2—Plot plan of the refinery, indicating the expansion space which has been left adjacent to each unit

Topping Operations

Charging capacity at Clarkson is 8250 b/d and the charge stock normally used is either Illinois crude, running 35-36° API gravity, or Oklahoma City crude, 36-37° API gravity.

The crude oil is pumped from storage through an oil-fired furnace, where it is heated to approximately 675° F., and then flashed into the 112-ft. atmospheric topping or distillation tower. At the temperature of 675° approximately 65-70% of the oil is vaporized. The remaining 30-35%, the bottoms, is drawn off to storage and subsequently charged to the vacuum distillation units, which will be described later. The 65-70% of the charge which represents the vaporized portion of the crude is fractionated into the usual cuts—overhead, naphtha, kerosine, gas oil.

Temperature at the top of the tower is 200° F., and the overhead fraction removed at this point has a boiling range up to 250°. This straight-run overhead distillate, after condensing, is pumped through a preheater, where its temperature is increased to 160°, and then enters a stabilizing tower where the butanes and lighter fractions are removed.

The bottoms from the stabilizer have a Reid Vapor Pressure of 7# and after treatment to remove harmful sulfur compounds are used as "straight-run aviation base gasoline". The clear octane rating of this stock is 66.5-67.5 (ASTM motor method); with 4.6 cc. TEL this rating can be increased to as high as 87.5.

The overhead from the stabilizer is separated into liquefied butane and propane (which is charged to the gas absorber in the polyform unit) and methane and ethane (burned as fuel).

Getting back to the topping operations again, a few bubble decks down from the top of the tower, where the temperature is approximately 290° F., a naphtha fraction with a boiling range of 215-350° is taken off. After treatment to remove sulfur compounds and any disagreeable odors, this fraction may either be sold as V.M.&P. (varnish makers' and painters' naphtha) or charged to the polyform unit, as explained later.

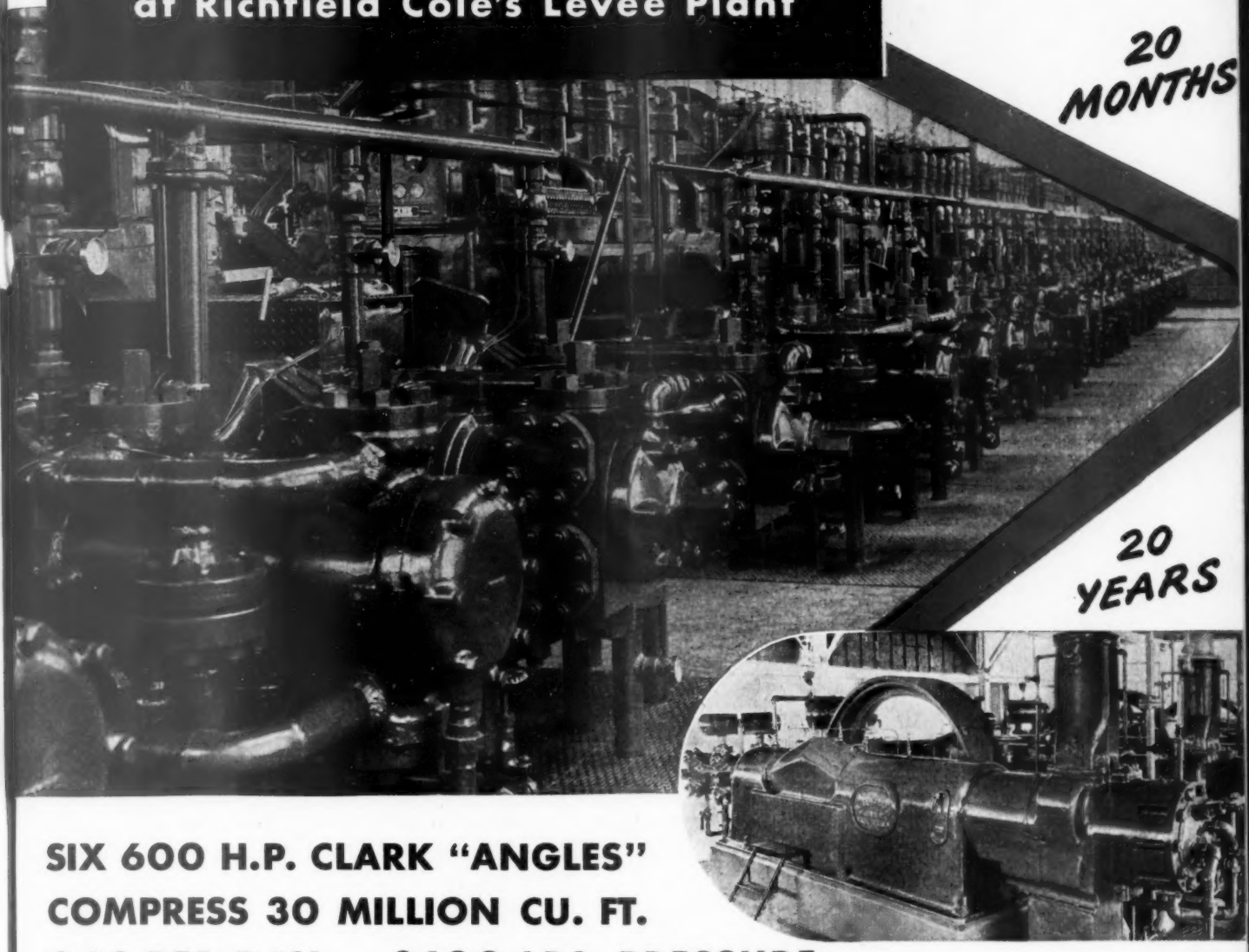
Still lower in the tower, at a temperature of approximately 360° F., another naphtha fraction, having a boiling range of 315-400°, is drawn off. This cut is marketed as mineral spirits or Stoddard solvent, or, depending on the market demand, is charged to the polyform unit.

The next cut taken from the tower is 500° E.P. kerosine, which is treated and sold as such, although, like the preceding naphtha cuts, it may be charged to the polyform unit to be cracked into gasoline.

The heaviest fraction taken off in the topping tower, exclusive of the topped crude bottoms, is a 700° E.P. gas oil,

LEFT—General view of various towers at Clarkson. Left to right—aviation gasoline re-run tower, primary vacuum distillation tower (a portion of the secondary tower is visible in the background), atmospheric distillation tower, polyform bubble tower

Old and New Clark Compressors at Richfield Cole's Levee Plant



SIX 600 H.P. CLARK "ANGLES" COMPRESS 30 MILLION CU. FT. GAS PER DAY ...3400 LBS. PRESSURE

This modern Clark installation at Richfield Oil Company's Cole's Levee Plant was placed in pressure maintenance service in October, 1943. The plant is compressing 30 to 31 million cu. ft. of gas per day against 3400 lbs. pressure. The first large-scale pressure maintenance project in California, its operation has been so successful that it has led to the sale of many more Clark Compressors for similar plants.

At an age when many compressors have gone to the scrap pile, the old Clark Compressor, shown in the smaller illustration above, is still going strong. It has served at several Richfield plants in its 20-year life and at Cole's Levee since 1939. The engineer, writing about this and several other old Clark Compressors, says:

"They have been in constant service, with the only work done to them a yearly inspection."

CLARK BROS. CO., INC. • OLEAN, NEW YORK

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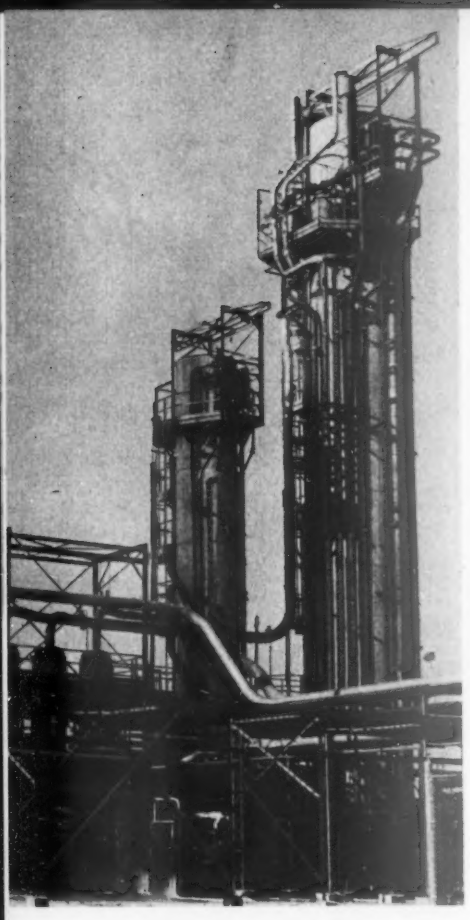


ABOVE—Primary (at the right) and secondary vacuum distillation towers for separating the lube oil fractions prior to solvent treating and dewaxing. The three steam stripping towers at the left improve flash characteristics

which is charged directly to the "poly" unit bubble tower.

The operations just described are followed when the main objective is the production of 87 octane aviation gasoline. If motor fuel is more in demand, then the overhead stream and two naphtha streams are all taken off together to yield a 400° E.P. straight-run gasoline.

Vacuum Distillation

The 30-35% bottoms from the crude topping tower, containing some heavy gas oil, lubricating oil fractions and asphalt, have a composite API gravity of approximately 20°. The gas oil and asphalt are taken out as such, but the lubricating oil fractions are separated into four distinct distillates or streams, each destined for a definite end product as follows:

Distillate	Finished Oil
A	SAE 10
B	SAE 30
C	SAE 50
D	Aviation 120 or Automotive SAE 70

All of this separation of the topped crude takes place in two vacuum distillation towers (primary and secondary) operating at reduced pressures ranging from 25 to 100 mm. Hg at the flash zones. These reduced pressures make it possible to vaporize and distill all of the lubricating oil content of the bottoms at a maximum temperature of 770° F. If the separations were made at atmospheric pressure, a top temperature of over 1000° would be required, and at this degree of heat a sizable portion of the oil would be cracked and decomposed into lighter products of no lubricating and market value. The amount of such decomposition which takes place at the temperature-pressure ratio used in B-A's primary and secondary vacuum distillation units is negligible. As a result, the further processing of the lubricating oils is easier because of their minimum content of decomposition products and the quality of the finished oils is improved.

The flow of products through these towers is shown in Fig. 3. The bottoms from the topping tower are first heated to 770° F. and then flashed into the 105-ft. primary vacuum tower, which operates under a pressure of 25-30 mm. Hg. Four cuts are taken in this first tower:

1) Penetration asphalt as bottoms.

2) Distillate D, which finishes as Aviation 120 or Automotive SAE 70 lubricating oil.

3) Distillate C, which finishes as SAE 50.

4) Bulk distillate as overhead.

An additional side stream of extremely viscous slop oil can be drawn off below distillate D if desired, to be used to control the quality and penetration of the asphalt fraction.

The overhead bulk distillate is reheated to 650° F. and then enters the 80-ft. secondary vacuum tower, which operates at 50-100 mm. Hg. Three fractions are taken off in this secondary tower:

1) Distillate B as bottoms, which finishes as SAE 30.

2) Distillate A, which finishes as SAE 10.

3) Heavy gas oil as overhead, which furnishes part of the charge to the polyform unit.

Distillates C and D from the primary tower and distillate A from the secondary tower are each passed through separate side stream strippers to obtain high flash characteristics.

Properties of the four raw lubricating oil distillates as produced in the vacuum towers are given in Table 1. Each of the distillates is run to storage and held for individual processing later in the Furfural extraction, MEK dewaxing, and contact filtration units.

Furfural Solvent Extraction

The first step in the further processing of the various lube oil cuts is the removal of undesirable aromatic hydrocarbons, accomplished in a furfural solvent extraction unit. The waxy distillate to be treated is heated to 130-150° F. and then pumped into the side of the 100-ft. contact tower, which is packed with one-inch Raschig rings. Simultaneously the furfural, at about 280° F., is pumped

TABLE 1—Properties of Raw Lubricating Oil Distillates Before Treating, Dewaxing and Contact Filtration

Distillate	A	B	C	D
End Product	SAE 10	SAE 30	SAE 50	SAE 70°
Viscosity Index				
@ 100° F., SSU	88	...	...	...
@ 210° F., SSU	...	67	105	200
Flash, °F.	410	490	520	595
Carbon Residue, wt.-%	.1	.1	1.0	2.5
Neutralization No.	0.07	.10	0.10	0.10
Amount of cut† % of initial charge to topping tower	9	6	4	4

°—Aviation 120.

†—Also produced are 8% asphalt and 4% secondary gas oil.

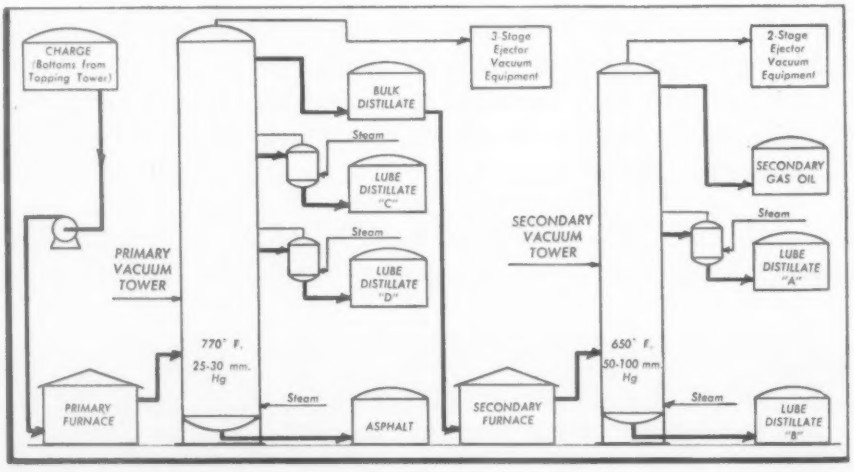


Fig. 3—Flow of products through the vacuum distillation towers. The low operating pressures in these towers are credited with producing lube oils with a minimum carbon residue

PROOF that Edward streamlined flow cuts pressure loss, saves money

Here's evidence that pressure loss through your small globe valves can be greatly reduced, or that greater volume of flow can be had with the same pressure loss, by standardizing on Edward 60° stem forged steel globe valves.

See the result of Edward Valve streamlining in less turbulence, higher efficiency and maximum volume at the equipment where it's needed.

$$h = \frac{1}{K^2} \cdot \frac{w^2}{1891^2\, D^4\, \rho}$$

THIS formula for computing pressure drop is based on material presented in *Fluid Meters—Their Theory and Application.** Provided the value of K is known, pressure drop through any valve can be calculated accurately. K is a factor dependent upon the general shape and contour of the valve and is determined by experimentally measuring flow and pressure drop through the valve. If resistance to flow is low, K approximates 1; with high resistance to flow, K approaches 0. Values for K, shown below, for Edward Fig. 2688 type valve and typical ordinary forged steel globe valve were determined through experiments on Edward flow test lines.

*American Society of Mechanical Engineers, 1937.

h—pressure drop through valve, psi.

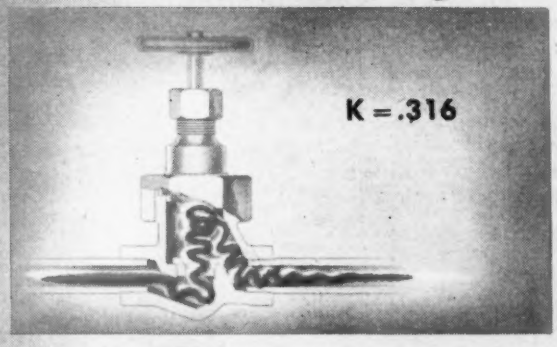
K—valve (or flow) coefficient.

w—weight of fluid through valve, lb/hr.

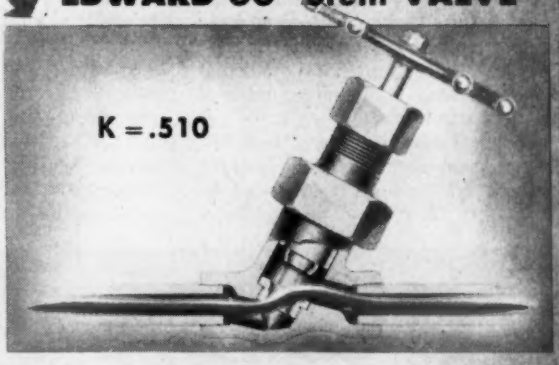
D—nominal pipe size.

ρ—density of flowing fluid, lb/cu. ft.

"X" VALVE



EDWARD 60° Stem VALVE



Steam . . . 10,000 lb/hr, 740 F, 525 psi, 2" line

$$h = \frac{1}{.316^2} \cdot \frac{10{,}000^2}{1891^2 \times 2^4 \times .797} =$$

h (pressure drop, psi) = 21.9

$$h = \frac{1}{.510^2} \cdot \frac{10{,}000^2}{1891^2 \times 2^4 \times .797} =$$

h (pressure drop, psi) = 8.44

Water . . . 50,000 lb/hr, 300 F, 900 psi, 2" line

$$h = \frac{1}{.316^2} \cdot \frac{50{,}000^2}{1891^2 \times 2^4 \times 57.4} =$$

h (pressure drop, psi) = 7.65

$$h = \frac{1}{.510^2} \cdot \frac{50{,}000^2}{1891^2 \times 2^4 \times 57.4} =$$

h (pressure drop, psi) = 2.94

Sharp turns in flow cause excessive turbulence (which promotes valve wear) and increase pressure drop (which wastes power). Edward 60° stem valves ease flow through with no sudden changes in direction.

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into the tower at a point near the top.

Being lighter, the oil fraction migrates to the top of the tower, while the heavier furfural descends to the bottom. As the two liquids are brought into intimate contact over the surface of the packing material, the undesirable naphthenic and aromatic hydrocarbons are preferentially dissolved by the furfural.

The furfural containing the dissolved hydrocarbons, known as the "extract", is drawn off at the bottom of the tower. It is heated and sent to fractionating towers, where the furfural is recovered and used again. The lubricating oil leaving the top of the tower, the "raffinate", has had its undesirable hydrocarbons removed by the counter-current contacting process. It also is heated and passed into fractionating towers, where the last traces of furfural which may have been carried over with it are removed.

Removal of the naphthenic and aromatic hydrocarbons by the furfural makes the oils more paraffinic and greatly increases their viscosity indices. The greater the ratio of solvents to oil being treated, the higher the viscosity index of the raffinate produced. Thus, from selected Mid-Continent crude oil, aircraft engine crankcase oils having viscosity indices of 95 or higher are produced, also automobile crankcase oils having viscosity indices of 80 to 95.

The quantity of the circulated furfural is from one to four times the volume of the lubricating oil being treated and is varied according to the degree of solvent extraction required. Paraffin oils and red oils intended for rough machine lubrication require the lowest ratio, whereas aviation oils require the highest ratio of furfural solvent circulation.

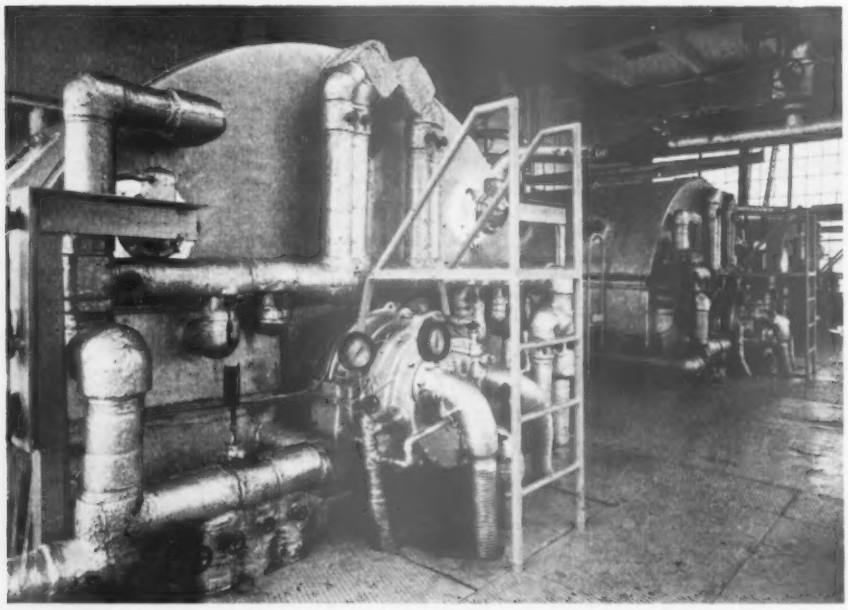
The furfural treating tower installed in the Clarkson plant has a number of interesting and unusual features. Its height, 100 ft., is greater than in most similar installations, and provides for a larger contact area and more complete counter-current extraction. In addition, the tower is provided with two intercooling sections for closer control of temperature, both take-off lines for circulating portions of the tower stream being located below the mid section of the tower and above the interface level. Better separation of raffinate and extract resulting in higher yields is obtained with this set-up.

MEK Solvent Dewaxing

The raffinates leaving the furfural tower still contain considerable paraffin wax which would interfere with low temperature service. The pour point of the oil at this stage of processing ranges from 110 to 130° F.

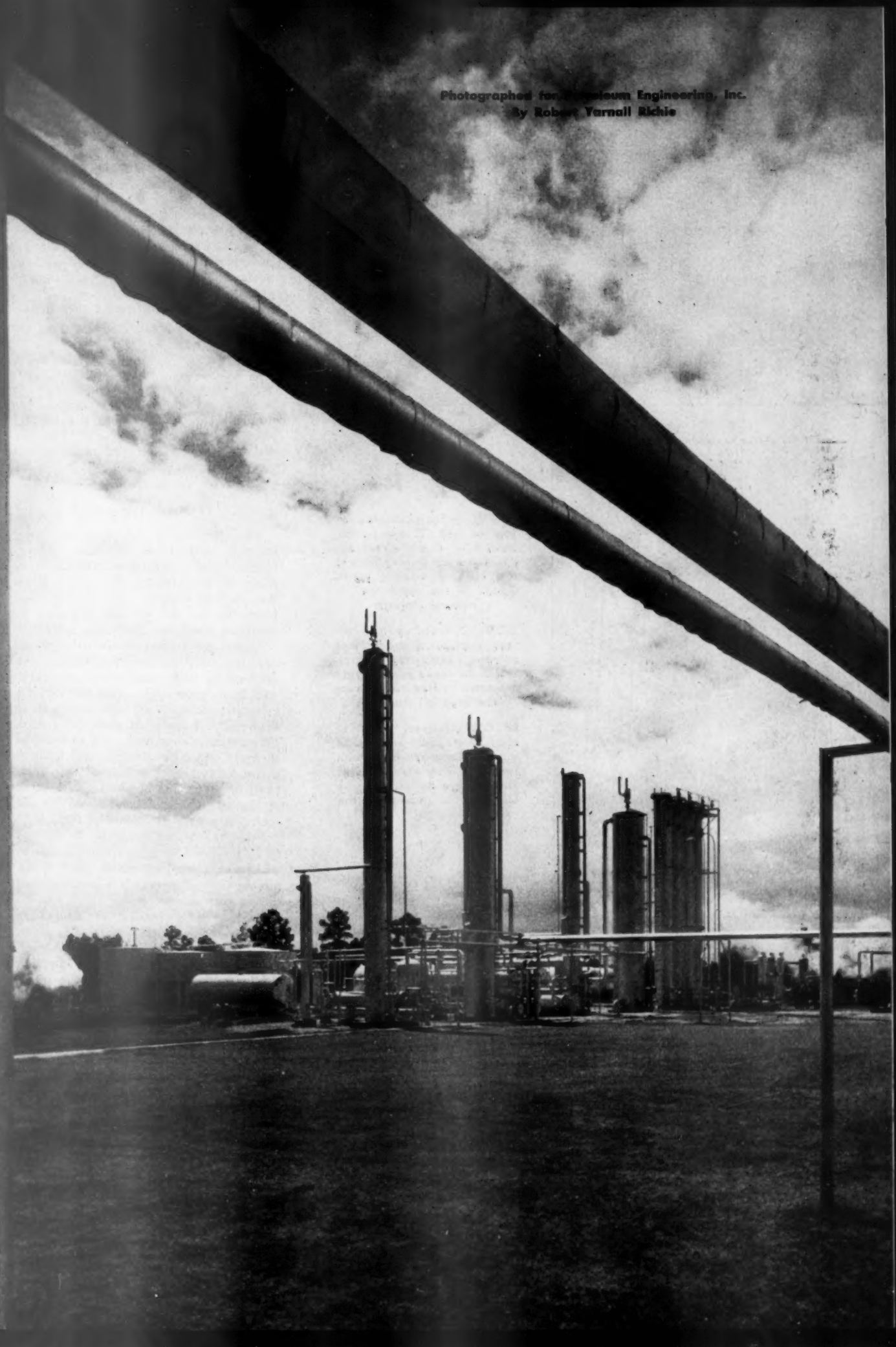
To remove this excess paraffin wax content and lower the pour point to the desired level, the next step in the treatment of the lube oils is MEK solvent dewaxing. In this phase of operations, the furfural-treated oil is mixed with a blend of methyl ethyl ketone, benzol and toluene in a ratio of approximately 1 to 2, the exact ratio depending on the charging stock.

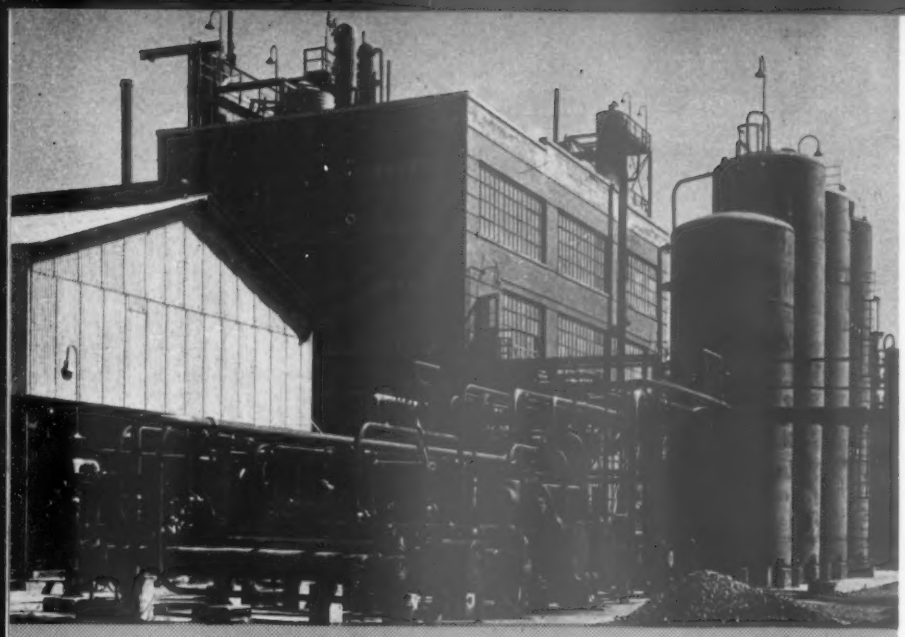
This mixture of oil and solvent is then charged to direct expansion ammonia chillers, where its temperature is lowered to approximately 10° F. below the pour point desired on the product. This temperature may be as low as −45° F., at which most of the objectionable wax crystallizes out. The benzene fraction of the solvent serves not only to lower the viscosity of the raffinate but through its compatibility with the oil it increases the yield on filtration. The MEK fraction of the solvent also has a tendency to precipitate the wax out of solution. Revolving scraper paddles in filtrate-to-charge exchangers and in ammonia chillers keep the walls of the tubes free of

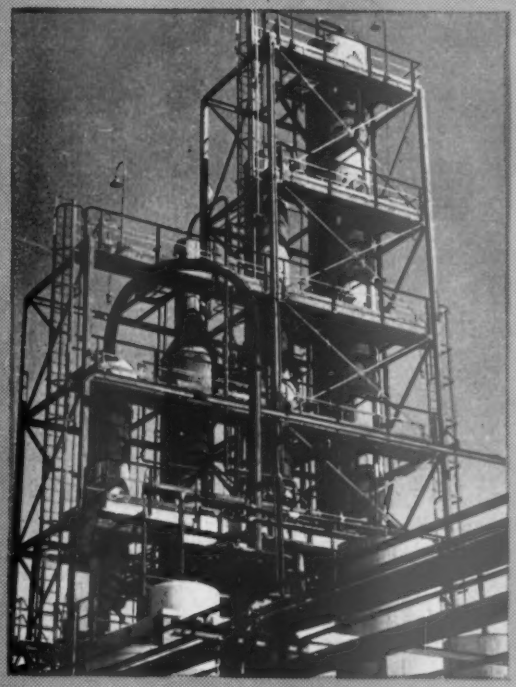


Filter room of the MEK solvent dewaxing plant at Clarkson, containing three rotary filters for separating the crystallized wax from the oil and solvent

One of numerous gas processing plants designed and constructed by Petroleum Engineering, Inc. during its 15 years of service to the industry. Petroleum Engineering, Inc. Offices: Tulsa and Houston.


Photographed for Petroleum Engineering, Inc.
By Robert Yarnall Richie

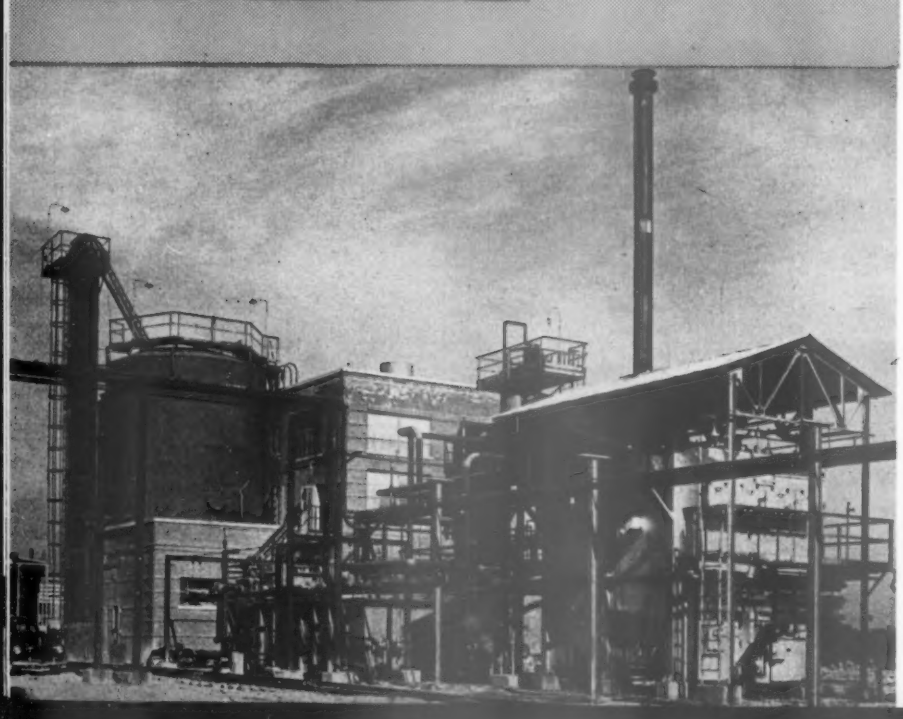




ABOVE — Temperatures as low as —45° F. can be obtained in these direct expansion ammonia chillers in the MEK dewaxing plant. Tanks to the right are for solvent storage

LEFT — Treating and recovery towers in the furfural solvent extraction plant, which removes undesirable aromatic hydrocarbons from the lube oil fractions

BELOW—General view of clay contacting section of the Clarkson refinery, with the unloading elevator and storage bin for clay to the left and the furnace to the right



wax deposits, and also break up the larger wax deposits to liberate entrapped oil.

Leaving the ammonia chillers, the mixture passes through one of three rotary filters, in which the crystallized wax is separated from the oil and solvent, washed to remove any remaining oil, and removed to a melting tank.

The dewaxed raffinate is heated and fractionated to separate the oil from the solvent. The solvent is returned through a cooler and recycled through the system, while the wax-free oil, which now has a pour point as low as −35° F., is run to storage.

Although most operations require using a chilling temperature of only −10° F., which produces a 0° F. pour point oil, refrigerating capacity has been installed sufficient to chill the mixture of oil and solvent to as low as −45° F., making possible the production of oils having a pour point of −35°F. if demanded by the market.

Contact Filtration

The lubricating oil fractions after vacuum distillation, Furfural solvent treating and MEK dewaxing are now ready for final treatment—contact filtration, which improves the demulsibility properties of the oil and increases its oxidation resistance and color stability.

In this process the solvent-treated and dewaxed oil from the preceding two operations is fed continuously, together with finely ground clay, into the top of a cylindrical tank 10 ft. high and 5 ft. in diameter and equipped with an agitator. From this mixing tank, the well-mixed slurry of oil and clay is pumped through a furnace, where it is heated to a temperature 40 or 50° below the flash point of the oil, which, depending on its viscosity, is usually from 300 to 500° F.

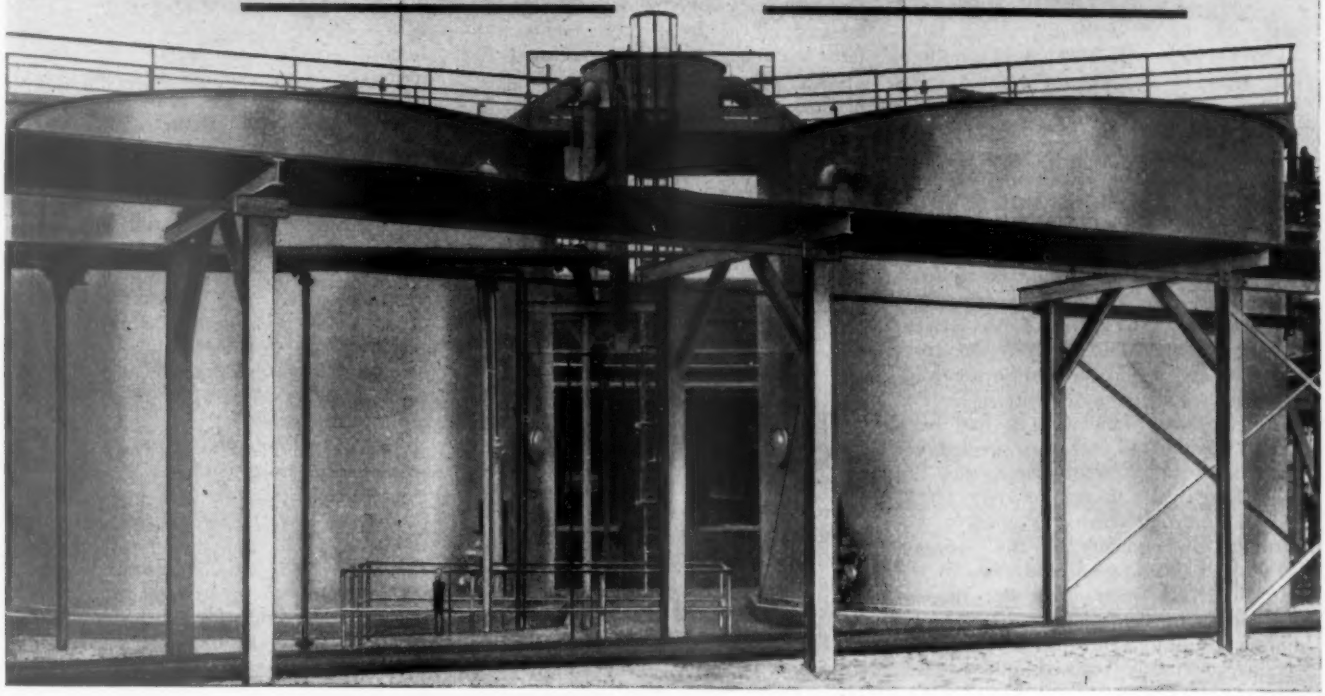
From the heater the slurry is charged to an insulated vacuum contact tower in which, at normal operating level, a 40-minute contact period is allowed. It is during this contact time, which can be regulated by increasing or decreasing the rate of flow of oil through the plant, or by raising or lowering the tower level, that the desired treatment is effected. While resident in the tower, the oil is stripped with steam to remove volatile impurities.

It is then pumped to a continuous vacuum precoat filter, where the spent clay is removed from the oil, the clay being deposited on the surface of the precoat and the oil flowing out of the filter drum to a filtrate receiver. Separation of the clay from the oil is such that the spent clay cake contains only 1 to 2% of the oil charged.

The Clarkson refinery, according to B-A, is the first plant ever designed to use the Oliver precoat filter in lube oil manufacture. Other plants use that type of filter, of course, but none was designed specifically to accommodate it.

Secondary filtration through two blot-

Softens and Clarifies
in less time at lower cost



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ter presses operating in parallel is the final operation and makes certain that no clay fines or other impurities remain in the finished oil.

Unusually long runs have been obtained at the Clarkson refinery in the operation of the precoat filter. At the beginning of operations the filter drum has a coating of about 2½ in. of diatomaceous earth, which serves as the filtering agent in the separation of the oil and spent clay. As the drum revolves and the spent clay is deposited on the precoat, a knife blade moves against the precoat and with each revolution cuts off a few thousandths of an inch of the coating together with the clay which has been filtered out. Normal operation usually calls for cutting the precoat continuously, so that within four days as a rule the thickness of the coating on the drum would be reduced to a half inch and would have to be renewed, a process taking several hours.

At Clarkson, however, it has been found possible to cut the precoat intermittently, thereby increasing its life to as long as 3 weeks, or over 500%. This intermittent cutting is possible, according to engineers at the refinery, because of the original separation of the lubricating oil fractions in the vacuum distillation towers. Under present operating conditions in the vacuum towers, as previously pointed out, a minimum of decomposition of the oil takes place. As a result, less objectionable products remain in the oil when it reaches the contact filtration process and less clay is required to remove them. With less clay being used, the coating of spent clay on the precoat filter doesn't build up as quickly and doesn't have to be cut off as frequently—hence intermittent cutting and longer operating life.

At present the intermittent cutting is handled manually. Plans are now being considered, however, to make this operation automatic. According to these plans, whenever the vacuum inside the filter drum goes above a certain level, indicating that the coating of spent clay on the precoat is clogging the filter, a ratchet will be activated to move the knife in and cut off a few thousandths of an inch of the precoat, this action continuing until the vacuum is restored to the proper operating level.

Polyforming

Designed to make either 87 octane (ASTM motor method) aviation gasoline with 4 cc TEL or 79-84 octane motor gasoline with 3 cc TEL, the polyform unit at Clarkson (Fig. 4) is equipped with a dual coil furnace and charges both naphthas and heavy gas oil.

Charge stock is fed to the unit in two streams. The "heavy oil" charge stock consists primarily of the secondary gas oil from the vacuum tower and the heavy gas oil from the crude topping tower. It may also include, depending on market demands, any of the four raw lubricating distillates which are in excess of requirements.

The "light oil" charge consists mostly of excess straight-run naphtha and mineral spirits from the topping tower, although small amounts of excess kerosine may also be used when available.

When operating to produce a maximum of aviation gasoline, the proportions of light and heavy charging stocks are about equal, although a 70% heavy gas oil and 30% naphtha ratio is normal for maximum motor gasoline production.

Because of the great diversity of charging stocks, a pre-separation of the light and heavy fractions is effected as the first step in operation. The heavy charging stocks are pumped to the main bubble tower, which operates at 650° F. and 400 lbs. pressure.

Two side streams are drawn from the main bubble tower. One is a light fraction which is pumped to storage and recycled as required with the light oil charging stocks; the other is a domestic fuel oil cut. The Polyform gasoline passes overhead together with the circulated and freshly formed gases.

The bottoms from the main bubble tower constitutes gas oil charge to the

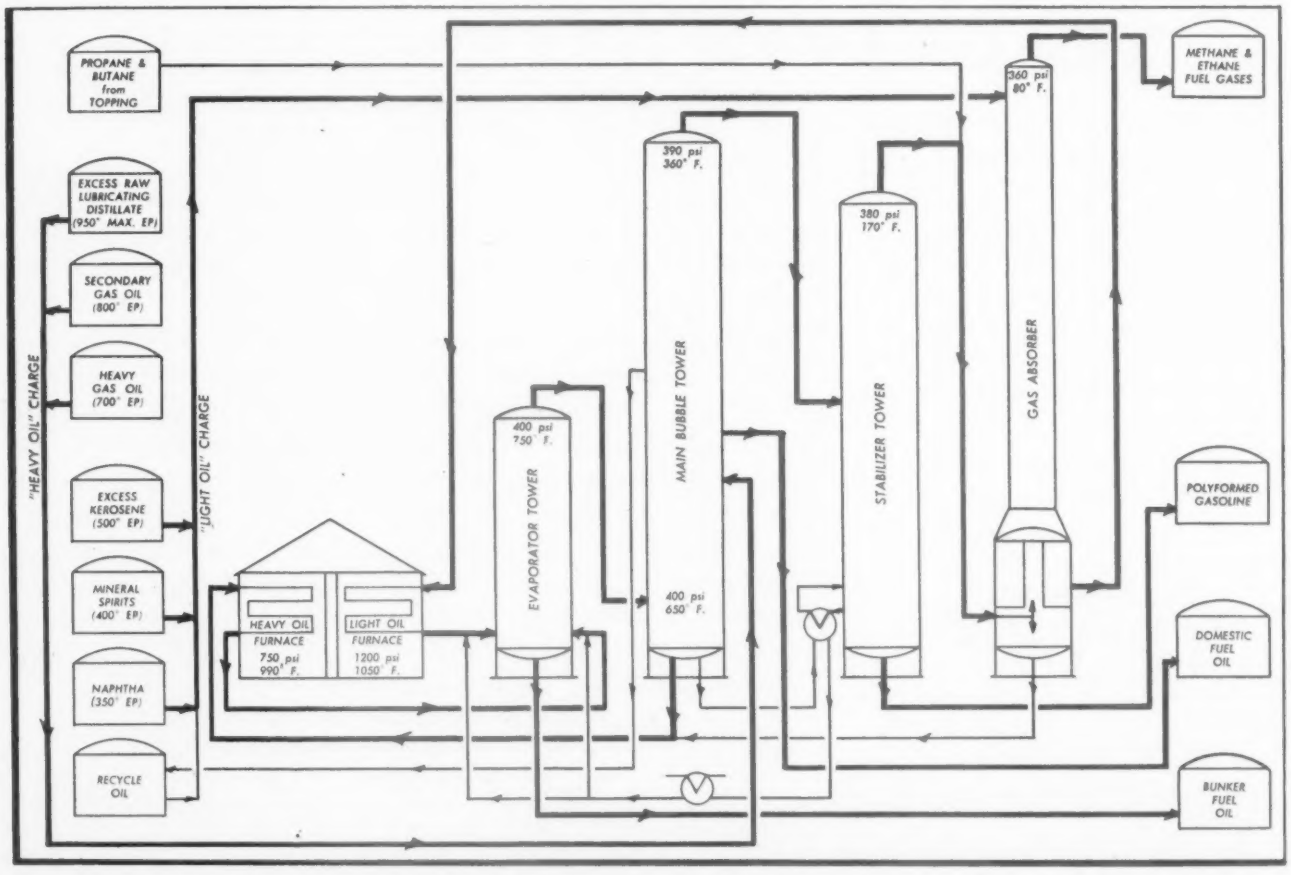
PROPANE & BUTANE from TOPPING
EXCESS RAW LUBRICATING DISTILLATE (950° MAX. EP)
SECONDARY GAS OIL (800° EP)
HEAVY GAS OIL (700° EP)
EXCESS KEROSENE (500° EP)
MINERAL SPIRITS (400° EP)
NAPHTHA (350° EP)
RECYCLE OIL
"HEAVY OIL" CHARGE
"LIGHT OIL" CHARGE
HEAVY OIL FURNACE 750 psi 990° F.
LIGHT OIL FURNACE 1200 psi 1050° F.
EVAPORATOR TOWER 400 psi 750° F.
MAIN BUBBLE TOWER 390 psi 360° F. 400 psi 650° F.
STABILIZER TOWER 380 psi 170° F.
GAS ABSORBER 360 psi 80° F.
METHANE & ETHANE FUEL GASES
POLYFORMED GASOLINE
DOMESTIC FUEL OIL
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Fig. 4—The Clarkson polyform unit charges two stream (heavy and light) and is designed to turn out either 87 octane aviation fuel or 79-84 octane motor fuel with TEL added

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heavy oil cracking coil, and, together with 70% of its volume of the overhead condensate from the stabilizer is pumped to the furnace, where it is heated to 990° F., at a pressure of 750 psi.

From the heavy oil furnace, the charge goes into an evaporator tower. Just before entering the evaporator, however, its temperature is sharply reduced by introducing a stream of cooled recycle oil, previously withdrawn from the main bubble tower bottom and passed through a reboiler and heat exchanger to bring its temperature down to 500° F. This shock cooling of the cracked vapors from the heavy oil furnace eliminates the formation of low pressure coke upon release of the coil pressure.

Bottoms from the evaporator tower are pumped to storage and sold as bunker fuel oil, while the overhead distillate, maintained at 400 lbs. pressure and 750° F., passes into the main bubble tower and undergoes a similar fractionation and cycling as described above for the heavy charging stock.

The light oil charging stock is run first into the gas absorber tower, where it is saturated with approximately 150% of its volume of the C_3's and C_4's from the stabilizer. The enriched light oil is then pumped into the light oil charging furnace maintained at 1200 psi. pressure and 1050° F. As with the heavy oil charge, the light oil charge is also shock-cooled before entering the evaporator tower for fractionation and cycling as described above.

Auxiliary Facilities

The Clarkson refinery has an abundant water supply at its doorstep—Lake Ontario, whose waters seldom go above 70° in summer or below 32° in winter. Because of lake currents, sediment and other foreign matter are continuously washed away from the shore, so that the water is exceedingly clean and contains only about 100 ppm of solids.

A 42-in. intake line extends over 1000 ft. directly out into the lake, the end of the line being 21 ft. below the level of the lake. Normally, with the intake point so far down, no difficulty is experienced with ice formation in even the coldest weather. This past February, however, there was one day when the lake water at that depth apparently was in a supercooled condition so that the slightest disturbance would throw ice crystals out of solution. The slight agitation at the mouth of the intake line was sufficient to cause that disturbance and upset the condition, so that a heavy layer of needle ice formed on the bars screening the intake opening and soon blocked the entrance to the line completely.

The first indication of trouble was a loss of suction at the pump house, and the condition quickly became serious enough to close down the entire refinery. A diver hastily summoned from nearby Toronto soon located the trouble and with the aid of a crowbar got things back to normal.

One problem which Clarkson has that is not common to most U. S. refineries concerns the year-around availability of its crude charging stock. Lacking a pipeline connection and because of its lake location, it depends entirely upon shipments of crude oil from the States by lake tankers. During the winter months, however, the refinery, like all other ports on the Great Lakes, is icebound. A reserve supply of crude sufficient to last through the winter months must consequently be built up during the time when the lake is open. Clarkson's present crude storage capacity of 700,000 bbls. is large in comparison to its charging capacity of 8250 b/d, but not too large when it is considered that it must last all winter long.

To accommodate tankers bringing crude to the refinery or carrying finished products to the distribution centers, B-A has built at Clarkson the largest privately-owned dock in the Great Lakes. It is 1850 ft. long by 32 ft. wide, and can accommodate at one time four 24-ft.-draft tankers. Most of the tankers docking at the refinery are company owned, since the British American Oil Co. operates on the Great Lakes a fleet of five vessels, four of 22,000-bbl. capacity and one of 2200-bbl. capacity.

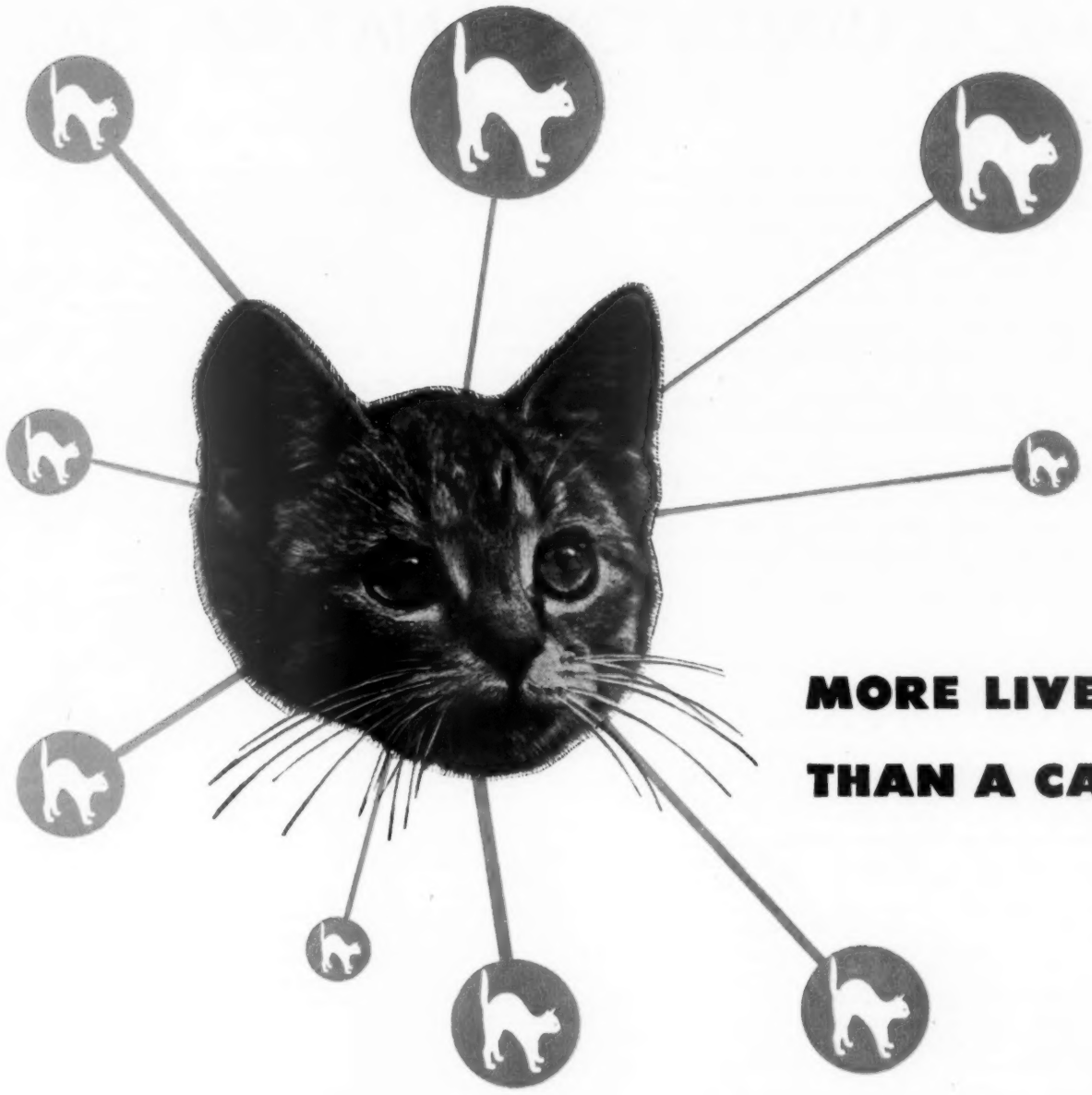
In addition to tanker facilities, the refinery has direct connections with transcontinental rail lines and through truck highways.

Steam is supplied by the refinery's own boiler plant, which is equipped with three boilers capable of producing 180,000 lbs. of steam per hour and fired with either oil or gas. Electric power is purchased outside, at 26,000 volts, and stepped down to 2300 volts for underground distribution to seven key substations located throughout the plant. The substation transformers reduce it again to 110 or 550 volts for final use.

Facilities at the plant also include a well-equipped control laboratory, housed in a one-story brick building 50 by 200 ft. and including crude-evaluation, asphalt, and distillate and lubricating oil laboratories; quantitative analytical chemical laboratory and balance rooms; soundproof engine room for octane-rating tests; instrument repair shop; low-temperature gas-analysis laboratory; first-aid room, and offices for the chemists and process foremen.

While at the present time the laboratory staff of 28 chemists and technicians is employed mainly for control work, it is anticipated that after the war the staff will be enlarged to keep pace with demands in oil refining and oil chemistry.

RIGHT—Typical of the neatness and efficiency at British American's Clarkson refinery is the architecture and landscaping around the main administration building, the entrance of which is shown here



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CHEMICAL UTILIZATION of NATURAL GAS

By Benjamin Miller

The utilization of natural gas in the postwar period for non-fuel purposes is discussed from both a scientific and realistic basis. Such non-fuel uses as for the production of carbon black, synthetic ammonia, aviation gasoline and synthetic rubber materials may be expected to level off or decline in the immediate postwar years, it is brought out.

Uses which may be expected to become increasingly important include the manufacture of chemical products for use as solvents and for the production of plastics, synthetic fibers, coating materials and the like. While olefins can be made from natural gas hydrocarbons as starting points for a great variety of important chemicals, here they must compete with olefins produced as a by-product of petroleum refining operations.

Although the chemical utilization of natural gas will increase it will remain of minor importance from the standpoint of natural gas consumption. Also the present known processes for chemical utilization cannot be considered as a means to reduce the wastage of natural gas, though further research may lead to the development of a process applicable to gas which would otherwise be wasted.

ALL things, the ancient philosophers believed, could be expressed in terms of four elements: fire and water, earth and air. Today we still find it convenient to use two fundamental concepts, matter and energy, although Einstein has taught us they are but differing aspects of a single entity. Natural gas is important primarily as a source of energy, a convenient fuel, and only in a relatively minor way as matter to be used or transformed. It is with this minor use of natural gas that the present report is concerned, with what one can do with natural gas besides burn it.

To say that the annual production of natural gas is of the order of four trillion cu. ft. may give some idea of the amount of matter with which we are concerned. It may be helpful to point out that this quantity of gas weighs about 100,000,000 tons and thus on a weight basis the natural gas industry has an annual production about equal to that of the steel industry.

Contains Many Chemicals

Chemically speaking, natural gas is a mixture of compounds, predominantly hydrocarbons, but with minor components including nitrogen, carbon dioxide, hydrogen sulfide and traces of other sulfur compounds, and occasionally helium. So far as I know natural gas is never prized for its nitrogen content and natural-gas nitrogen would be used chemically only where it happened to be mixed with atmospheric nitrogen, the mixed nitrogen being obtained from products of natural gas combustion.

Some natural gas is very rich in carbon dioxide and such natural gas has been processed for the production of solid carbon dioxide, so-called dry ice. Hydrogen sulfide is an objectionable component whose removal has been practiced for some time. Very recently, hydrogen sulfide removed from natural gas has been treated for the production of elemental sulfur. While the amount of sulfur produced in this way is quite small compared to the total sulfur production, the operation is of great interest and may be practiced on a larger scale in the future.

Source of Helium

The remaining minor component, helium, has had considerable publicity because of its use in lighter-than-air craft. When war-secrecy restrictions have been lifted we may learn how large a part the helium-inflated units of our Navy played in winning the battle of the Atlantic. This Committee has a special interest in helium because much of the research carried on by the Bureau of Mines in cooperation with the American Gas Association under the sponsorship of this Committee was done at the Amarillo laboratory established as part of the helium program; and it was to increase helium production that the personnel formerly occupied in such research was transferred.

Helium has other uses perhaps less spectacular. A synthetic atmosphere containing helium instead of nitrogen has been found particularly useful for deep sea divers and others whose work in compressed air exposed them to the occupational disease called "the bends", which is due to solution of nitrogen in the blood when the worker is exposed to the high pressure and bubble formation as the nitrogen comes out of solution when the worker comes back to a normal pressure environment. Helium has also been suggested as a component of anesthesia mixtures and experiments with such mixtures have been carried on in hospital operating rooms. By keeping the atmosphere away, a protective blanket of helium has also made possible a successful process for arc-welding magnesium, which is so active chemically that it combines not only with oxygen but also with nitrogen at welding temperatures.

Carbon Black

The hydrocarbons which are the principal components of natural gas are composed of carbon and hydrogen, the carbon making up 75% by weight of methane, the simplest, and greater proportions of the other hydrocarbons. By far the most important of the chemical uses of natural gas from the standpoint of volume is the manufacture of carbon black and this is also the oldest use of natural gas as a source of matter rather than energy. Hundreds of thousands of tons of carbon black are produced each year from hundreds of billions of cu. ft. of natural gas. The carbon black industry has been in existence for many years but it is still changing and will doubtless continue to change.

A definitive study of the chemical utilization of natural gas must include consideration of the carbon black industry. The development of the carbon black industry indicates certain trends and illustrates certain economic factors which will be important to a greater or lesser extent in the development of any other industry based on natural gas as a raw material.

Several processes are in use for the manufacture of carbon black, but until recently the channel process accounted for all but a small fraction of the total production. One distinguishing feature of the channel process is the small yield.

Recovery Is Only 5%

Less than 5% of the carbon in the gas is recovered as carbon black. This low yield has several effects. It makes it necessary to use large volumes of gas to produce channel-process carbon black at a commercial rate. Since the price at which the product sells is relatively low, that is, a few cents per lb. for the great bulk of it, only low-priced gas could be used.

The money yield as well as the material yield being low, the use of natural gas as a raw material for channel-process carbon black came to be considered an inferior use. The carbon black industry had to move away from a locality as soon as the price at which natural gas could be sold there for fuel became greater than its value for carbon black manufacture. In some states the use of natural gas for carbon black manufacture was restricted by law.

Other processes were developed which produced more pounds of carbon black

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This paper was originally prepared as a report to the Technical Research Committee, Natural Gas Department, American Gas Assn.

Benjamin Miller is on the research staff of the Institute of Gas Technology, affiliated with the Illinois Institute of Technology, Chicago.

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per MCF but the carbon black produced by these other processes was less desirable for the major carbon black market, that is, for use in rubber tires. The shift from natural rubber to synthetic rubber changed the picture. Carbon black made by other processes, notably by the furnace process, was found to be relatively more suitable for use in synthetic rubber tires than it had been for use in natural rubber tires. The spectacular growth of the synthetic rubber industry was accompanied by a less publicized but tremendous increase in the production capacity for furnace-type carbon black.

Furnace-type carbon black can be made in yields of 25% and higher rather than 5% or less. Thus, insofar as furnace black can serve purposes formerly exclusively served by channel black, the carbon black industry takes on a new aspect. If five times as much product can be made per unit of gas consumed, the value of natural gas for carbon black production may increase considerably before it hits the ceiling imposed by the market value of the carbon black produced. Furthermore, the high material yield makes it very difficult to consider the production of furnace-type carbon black an economic waste. It may even be that the production of furnace-type carbon black will some day be looked upon as a superior use of natural gas.

Another important effect is that the amount of gas required for a commercial size plant is much less. A furnace-type carbon black plant using 5,000,000 cu. ft. of natural gas per day is quite large enough to be practical.

Other Methods of Manufacture

Both furnace black and channel black are made by partial combustion of natural gas. Other methods for producing carbon black involve thermal decomposition of natural gas, carried on in such a way that no combustion products are mingled with the carbon black, though heat for the decomposition is generated by combustion. There are various modifications of this general process, and the products of the various modifications have properties differing from channel black and from furnace black, and among themselves. Uses for these thermal decomposition carbon blacks have also increased. The thermal decomposition process also produces hydrogen, and in some cases the hydrogen is considered the main product and the carbon black the by-product; there will be more about hydrogen from natural gas later.

While the differences among the various carbon blacks are of great importance in connection with their several uses, for the present report it suffices to point out that the various types are not completely interchangeable and therefore price differentials exist and can be maintained. However, research by the various consuming industries is stimulated by such price differentials because the consumer has an incentive to modify his process so as to be able to use the cheaper carbon blacks, which are those made in higher yields. Also, the producers of the lower-priced carbon black are stimulated by price differentials to do research looking toward more nearly perfect control of the properties of their products so as to make them suitable for more varied uses.

Increasing Yields Predicted

It seems inevitable that as a result of these developments the average yield of carbon black from natural gas will increase. This will tend to make the cost of the gas itself a less important factor. Furthermore, if yield increases it becomes possible to think of making carbon black near the point of consumption rather than where the gas is cheapest. The cost of shipping carbon black from the points where cheap natural gas is available to the consuming centers may exceed the cost of the gas from which the carbon black is made, particularly in the case of high-yield processes. It would probably be feasible to make carbon black near the center of the consuming market if the yield were 30 pounds per MCF because the cost per MCF of moving natural gas by pipe line to a consuming center would probably be less than the cost of moving 30 pounds of carbon black.

It is thus possible to discern two opposing tendencies. As yield is increased, the amount of gas required for commercial operation decreases so that more locations become possible sites for carbon black plants. On the other hand, as the yield increases there should be a tendency to move the gas to the consuming market and produce carbon black close to the market. There is also to be considered the matter of by-products or concurrent products. It was mentioned above that hydrogen is produced along with carbon black by some processes and the hydrogen may be used in ways to be discussed below. Now the amount of gas necessary for such a commercial operation may also be relatively small, of the order of 5,000,000 cu. ft. per day. However, utilization of the hydrogen may restrict the location of the plant since hydrogen is relatively costly to transport, but there may be locations where both carbon black and hydrogen can be utilized.

Other By-Product Possibilities

The possibility exists of producing other by-products along with carbon black. This is more likely to come about if the higher hydrocarbons are used as raw material. It is quite possible to conceive of a process in which ethane-propane mixture from a natural gasoline plant will be partly converted into carbon black, the remainder being a gas having a reasonably high heating value so that it may be put in pipe lines for transportation to fuel markets.

Two further possibilities deserve consideration. Where furnace-type black is produced, the tail gas has so low a heating value that it cannot be economically placed into pipe lines for transportation to distant fuel markets, and generally there is very little use for it as a source of energy at the point of production. Near a consuming center, however, a large volume of low heating value gas may be valuable, so that it may become economically feasible to utilize the tail gas from a partial combustion carbon black process as a source of heat or of mechanical energy. Then consideration of economic waste could be entirely eliminated. The possibility therefore exists that gas may be transported from a location at which its use for carbon black manufacture would be uneconomical to another location and there converted into carbon black, and the tail gas utilized so as to make the entire process efficient in material use as well as economic.

Natural gas is not the only possible source of hydrocarbons from which carbon black can be made. It is known that carbon black is made from acetylene in Canada, the acetylene being derived from calcium carbide made in electric furnaces from coke and limestone. In England and Germany, according to published reports, carbon black is made from naphthalene or other hydrocarbons derived from coal by carbonization. While it does not seem that electric furnace acetylene or coal carbonization by-products are likely sources for carbon black in this country, there is the possibility that carbon black will be made from hydrocarbons derived from petroleum.

Carbon Black from Oil

There have been published reports that carbon black has been made, on an experimental scale, at least, from liquid hydrocarbons derived from petroleum. The cost of liquid hydrocarbons available for carbon black manufacture has probably been too high to make such a process economical if consideration be given only to raw material. However, if yields of carbon black sufficiently high can be obtained from low-priced liquid hydrocarbons, the saving in transportation cost may make production of carbon black from liquid hydrocarbons at points near consuming markets an economic possibility. Furthermore, hydrocarbon gases derived from petroleum are available at oil refineries, some of which are near carbon black markets. Production of carbon black from refinery gases at such locations appears to be a possibility under some conditions.

It has already been mentioned that the shift from natural rubber to synthetic rubber has had considerable influence on the carbon black industry and has caused increased demands for carbon blacks other than channel black. This is not to say that channel black is not used with synthetic rubber; on the contrary, the demand for channel black has also increased, but not to so great an extent. When natural rubber is once more available in quantity, will channel black regain its predominant position, or will the

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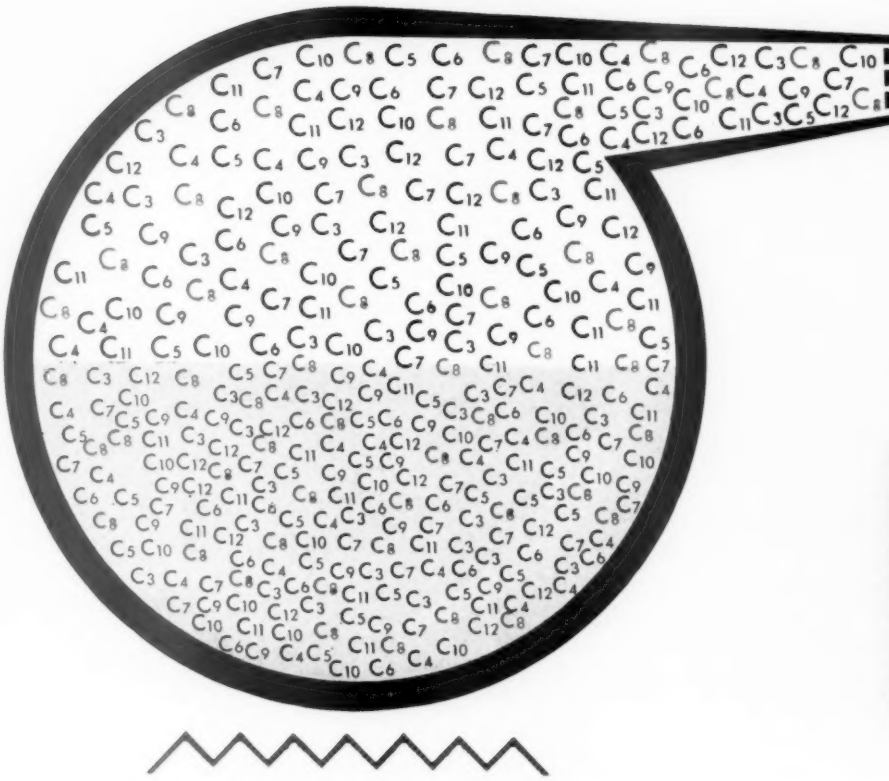

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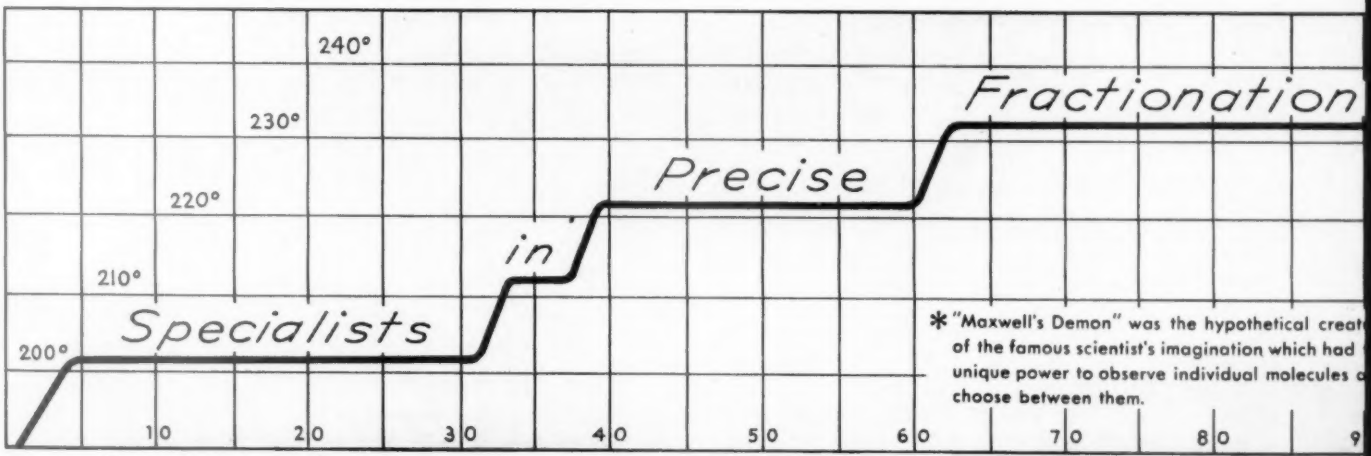

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improved position of other types of carbon black be maintained?

Any answer to this question must be based on some assumption as to the future relation between natural and synthetic rubber production. However, it seems fairly certain that manufacturers of other types of carbon black will succeed, at least to some extent, in modifying their products to make them useable with natural rubber to a greater extent than was the case in the past, and the rubber manufacturers will undoubtedly develop means of compounding natural rubber so as to take advantage of the desirable attributes of all types of carbon black.

See Increased Demand

While any prediction as to the relative importance of natural and synthetic rubber in the future would be extremely hazardous, it seems safe to predict that the total consumption of rubber of all kinds will increase steadily in the immediate postwar period, so that the market for carbon black afforded by the rubber industry should be expected to increase. It is also quite likely that there will be expansion in the demands for carbon black for other purposes and that these will be stimulated by research and development work which the carbon black manufacturers will initiate to expand their markets.

Taking all of the foregoing into consideration, it would appear that greater production of carbon black is to be expected in the future, but that on the average, the number of pounds of carbon black obtained per MCF of natural gas will also increase, and other raw materials may be used, so the total quantity of natural gas used for carbon black production may even decrease. Furthermore, the newer processes for carbon black production may make possible the use of gas which could not formerly have been considered for this purpose because the amount available was insufficient for commercial operation. Thus it is reasonable to expect that carbon black production will take less natural gas which might otherwise go into pipelines in the future than it has in the recent past.

One other point seems worthy of attention. In some places sour natural gas has been used for carbon black production though sweet natural gas could not be so used. At least one large producer of carbon black planned to treat sour gas for hydrogen sulfide removal before using the gas to make carbon black. While the plan seems to have been abandoned, the very fact that it could be seriously considered indicates that the cost of hydrogen sulfide removal has so greatly decreased that the distinction between sour gas and sweet gas with regard to their use as raw material for carbon black manufacture should be re-examined.

Synthetic Ammonia

The production of hydrogen by thermal decomposition of natural gas with concurrent production of carbon black may be considered from the standpoint of the carbon black being the principal product or the hydrogen being the principal product. At least one such operation has been going on for many years, the hydrogen being considered the principal product and being used in the manufacture of synthetic ammonia. A plant using about 5,000,000 cu ft of gas per day and producing 100 tons of ammonia per day is definitely commercial. For such a plant the cost of the natural gas is secondary, since the value of the ammonia produced is so great compared to the value of the natural gas consumed. Low-cost natural gas is undoubtedly desirable but not necessary for such an operation, and if other reasons make it advisable, such a plant could be located at a considerable distance from the producing wells.

When the war emergency required a tremendous expansion of the production of ammonia from which to produce nitric acid for explosives, natural gas came to mind immediately as a source of the necessary hydrogen. The war-emergency plants very largely used another process for hydrogen production, one in which natural gas is reacted with steam to form a mixture of hydrogen and carbon monoxide, the carbon monoxide reacted with additional steam to form carbon dioxide and more hydrogen, and the hydrogen and carbon dioxide then being separated. It has been stated that about one half of the emergency synthetic ammonia is produced from hydrogen made in this way.

Here again the cost of natural gas is not the most important factor, and plants may be located at considerable distances from the producing wells. It is extremely doubtful that synthetic ammonia production will continue indefinitely at the peak wartime rate. When the production rate drops the consumption of natural gas for this purpose will drop, although there exists the possibility that some plants using natural gas as a raw material may continue to operate while other plants based on coal as raw material may shut down.

Aviation Gasoline

The manufacture of hydrogen from natural gas by reaction with steam was first introduced into this country from Germany in connection with hydrogenation as a method of petroleum refining. Hydrogenation, in the sense of the conversion of low-gravity crude oil or of residual oil to motor fuel by hydrogen addition has not come into extensive use, but hydrogenation as part of a process for manufacturing aviation gasoline has become of considerable importance and such hydrogen is largely made from natural gas. The process involves an addition reaction of normally gaseous olefins such as isobutylene and hydrogenation of the resulting liquid olefin. Two isobutylene molecules, or an isobutylene molecule and a normal butylene molecule are caused to join, forming an eight-carbon-atom olefin which is then hydrogenated to form an isomer of octane. Generally a mixture of branched chain eight-carbon-atom paraffins is obtained, called hydrocodimer.

For the manufacture of aviation gasoline another process has been developed which uses isobutane extracted from natural gas. This process is called alkylation. Isobutane is caused to react with butylene to form in one step branched-chain eight-carbon-atom paraffins. This process is preferred to the one previously described because it is simpler and because the product is somewhat superior. The demand for isobutane for use in alkylation became so great that the supply available had to be augmented by converting normal butane to isobutane, the conversion process being called isomerization. The manufacture of aviation gasoline therefore uses hydrogen derived from natural gas, isobutane extracted from natural gas and isobutane produced by isomerization of normal butane extracted from natural gas.

Alkylation of C_4's Most Effective

In addition to alkylation with four-carbon-atom olefins, it is possible to alkylate isobutane with olefins having fewer or more carbon atoms. This is not generally practiced because the most effective use of isobutane can be made when butylene is alkylated. However, where there is locally an excess of isobutane and a supply of olefins other than butylene, it may be more economical to alkylate the other olefins than to move the isobutane to a location in which there is excess butylene.

The outstanding example from the natural gas standpoint is the production of isomers of hexane. This involves the reaction of ethylene with isobutane. Two general processes are in use, one of which produces principally 2-2, dimethyl butane, also called neohexane, while the other produces principally 2-3, dimethyl butane. The production of neohexane was first established on a commercial basis, but the production of 2-3, dimethyl butane is more desirable. For this process ethylene is prepared by cracking propane extracted from natural gas. Actually a mixture of ethane and propane can be used as raw material.

It is technically quite feasible to dehydrogenate butane to form butylene and therefore aviation gasoline could be made from normal butane by dehydrogenating one part of it to form butylene and causing the butylene to react with isobutane formed by isomerizing another portion of normal butane. However, this process seems not to be practiced, at least not on a large scale. The reason is that butylene is available in large quantities as one product of the catalytic cracking of petroleum fractions.

Another process, also called alkylation, is the addition of an olefin hydrocarbon to an aromatic hydrocarbon. For example, propylene may be added to benzene to form isopropyl benzene, or cumene, which is an important component of aviation

gasoline. Part of the propylene used in this operation is made by cracking butane extracted from natural gas.

Another method of converting natural gas hydrocarbons such as butane to aviation gasoline involves cracking to form olefins, then polymerizing the olefins. This method was one of the first used to convert normally gaseous hydrocarbons to liquids, but it is of less importance than others mentioned. Hydrogenation of the polymer improves the quality of the product.

Demands for Use In Aviation Fuel

The future use of natural gas and hydrocarbons extracted from natural gas for the manufacture of aviation gasoline on a large scale seems quite doubtful. Liberal estimates place the peace-time market for aviation gasoline at no more than 10% of the war-time peak production. A large part of the aviation gasoline is produced by catalytic cracking units and it may be that in the future most aviation gasoline will be so produced. There may be some production from butylene and isobutylene by addition and hydrogenation as described previously. Also some production of aviation gasoline by alkylation from butylene and isobutane may continue.

However, oil refineries have always produced some isobutylene, butylene and isobutane since cracking was introduced and the production of such four-carbon hydrocarbons is increased in the catalytic cracking process over what it was in the older thermal cracking process. From such considerations it would appear that natural gas would contribute very little to the peace-time aviation gasoline market. Nevertheless, some companies who have available large quantities of butane, isobutane, propane and ethane are undoubtedly giving serious consideration to manufacture of aviation gasoline during peace-time in competition with manufacture based on crude oil. Such operations are more likely to be carried on by companies engaged in oil refining as well.

Synthetic Rubber

Synthetic rubber, mentioned above in connection with carbon black is also important to the natural gas industry as a consumer of hydrocarbons extracted from natural gas. The greater part of the synthetic rubber is made by combination of butadiene and styrene. Butadiene is being made by dehydrogenation of butane extracted from natural gas. Styrene is being made from ethyl benzene produced by the alkylation of benzene with ethylene, the ethylene being produced by cracking of propane extracted from natural gas. However, natural gas plays but a minor part in the synthetic rubber program. Most of the butadiene has so far been made from ethyl alcohol, and ethyl alcohol has also been used in making styrene from benzene. But ethyl alcohol, while produced by fermentation for the most part, is also made from ethylene manufactured from propane.

Of the butadiene not made from ethyl alcohol, the greater part is produced from butylene which as previously mentioned is made by cracking oil, primarily by catalytic cracking. One of the largest butadiene-producing plants was originally planned to use butane as raw material. However, it was found that sufficient butylene from oil cracking was available in the neighborhood for the planned butadiene output. Since dehydrogenation of butane to butadiene requires the removal of twice as much hydrogen as dehydrogenation of butylene, the latter is the preferred raw material. If it were not that butylene is in even greater demand for aviation gasoline there would probably be no production of butadiene from butane at all.

Therefore, when the demand for aviation gasoline decreases and butylene becomes relatively plentiful, it is reasonable to suppose that butadiene manufacture from butane will cease. The production of styrene using ethylene produced by cracking propane may continue, since the extraction of ethylene from refinery gases is generally more difficult than the extraction of butylene. However, it is to be expected that further developments in processing refinery gases will increase the amount of ethylene extracted, and thereby decrease the production of ethylene by cracking of propane. The foregoing rests of course on the assumption that synthetic rubber production will continue on a large scale after natural rubber is again freely available. Of course if the production of synthetic should decrease, the demand for natural gas hydrocarbons for use in synthetic rubber production would be even less.

Efficiency Will Lower Consumption

There have been considered so far non-fuel uses of natural gas for production of carbon black, synthetic ammonia, aviation gasoline and synthetic rubber. It has been pointed out that carbon black production will probably increase but that the amount of natural gas required for carbon black production will probably decrease because greater efficiency in production is to be expected and the tendency is toward the use of types of carbon black which can be made in higher yield. Synthetic ammonia production capacity increased enormously for war purposes, but such production will almost certainly be cut very drastically during peace time so that the amount of natural gas used as a raw material in synthetic ammonia production may be expected to show a marked decrease.

Similarly, the production of aviation gasoline has increased until present production capacity is enormously greater than would have been considered possible a few years ago. Here again, peace time demand will be only a small fraction of the war time demand, and since it is the marginal aviation gasoline which was made from natural gas, generally speaking, the use of natural gas as a raw material for aviation gasoline manufacture may be expected to decrease markedly if not to disappear entirely. The situation with respect to synthetic rubber is not so clear.

Synthetic rubber may continue to be produced in large quantities even after natural rubber becomes freely available, and the use of ethyl alcohol as raw material for synthetic rubber production will decline. Nevertheless, the production of butylene by cracking oil will probably be more than sufficient to take care of any demand for butadiene for synthetic rubber. It seems safe to predict, therefore, that even if synthetic rubber production should maintain its present level or slightly increase, the amount of natural gas hydrocarbon used as a raw material for synthetic rubber production will probably decrease.

Chemical Products

The non-fuel uses of natural gas so far discussed have reached their peak of natural gas consumption or will shortly do so and in the immediate postwar period such consumption will level off and decline. Other non-fuel uses of natural gas may be expected to become increasingly important. Of these the manufacture of chemical products for use as solvents and for the production of plastics, synthetic fibers, coating materials and the like have had the most publicity although very little definite factual information about the hydrocarbon processing operations is generally available. A half dozen companies are actively engaged in the field of converting natural gas and natural gas hydrocarbons to strictly chemical products, though the latter are used by many other companies for the production of a vast number of synthetic materials.

In the discussion of such uses of natural gas, it is necessary to distinguish carefully between natural gas and refinery gases. The chemical industry which has grown up on the basis of refinery gases is already very large and growing rapidly. For the most part the olefins are the raw material of this industry. All of these olefins can be made from the natural gas hydrocarbons and, as already mentioned, some of these are being made. However, it has been well said that a synthetic can never supplant a by-product, it can only supplement it. Olefins are by-products of oil refining whereas they are synthetics when produced from natural gas.

Those companies utilizing refinery olefins as raw materials may find it profitable to supplement their supply by converting natural gas hydrocarbons into olefins, whereas to compete with olefins which are by-products of oil refining by making olefins from natural gas hydrocarbons can be economically sound only under very special conditions. For the purpose of this report, therefore, it will be sufficient to point out that olefins can be made from natural gas hydrocarbons and that they are starting points for a great

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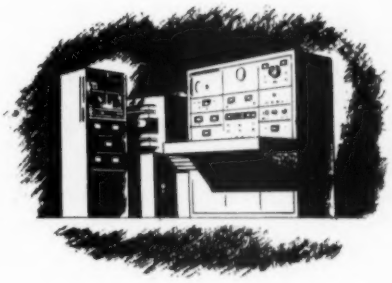

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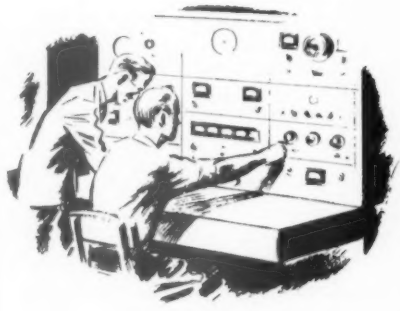

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variety of important chemicals but that such products are more properly considered chemicals derived from petroleum, rather than chemicals derived from natural gas.

Methanol Production Possible

Chlorinated hydrocarbons are among the most important solvents and are used very largely for cleaning of fabrics and degreasing of metals. Some of these chlorinated hydrocarbons can be made as readily from olefins by addition of chlorine as from paraffins by substitution of chlorine for hydrogen, so that they are made from both. Others can be produced more readily from olefins, but there are some which can be produced most economically from the natural gas hydrocarbons, and the use of natural gas hydrocarbons for the production of chlorinated solvents is growing and will probably continue to grow. A large increase of chlorine-producing capacity was generated by the war emergency and much of the new capacity was constructed in the Southwest near supplies of natural gas. It is to be expected that chlorine from these plants will be used to produce chlorinated solvents from natural gas in increasing quantities.

A comparatively recent development has been the production of nitroparaffins by the vapor-phase reaction of nitric acid with propane. The nitroparaffins may serve as starting points for a large variety of organic chemicals, some of which have not been commercially available before, while others have been made by more round-about processes at higher cost. Here again the cost of the propane is a relatively minor item, and the operation need not be conducted near the point of production of the propane.

Oxidation Products

Oxygen-containing organic compounds may be derived from natural gas hydrocarbons by controlled oxidation with atmospheric air. The possibility of producing valuable materials using as raw material only natural gas and air has intrigued chemists for many years, but it was only within the last 20 years that a successful process was worked out. This process produces principally formaldehyde and methanol, although acetaldehyde and other minor products are also obtained. More recently another oxidation process has reached commercial stature. Its principal product is said to be acetic acid, starting material for acetate-type synthetic fibers and plastics. Butadiene, discussed above as principal intermediate in synthetic rubber production, contains no oxygen, but a new plant to produce it is said to employ the aldol process, and aldol is an oxygen-containing compound which can be made from natural gas hydrocarbons by a process involving partial oxidation.

The total amount of natural gas and natural gas hydrocarbons used in these strictly chemical ways is not very great. It has been estimated that the prewar annual production of methanol, amounting to 20,000,000 gals., could have been produced from the gas from a single gas well of 10,000,000 cu. ft. daily capacity if conversion efficiencies were nearly perfect. Methanol production is now running at the rate of nearly 80,000,000 gals. per year and of course not all of it is being made from natural gas.

A recent estimate of the basic raw materials used to produce resins and plastics in 1941 included 690,000,000 cu. ft. of natural gas. While the present production rate for plastics may be double that of 1941, and while plastic production may continue to increase rapidly, it is obvious that plastics cannot for many years to come consume more than a very tiny fraction of the natural gas production. Other specialty chemicals made from natural gas and natural gas hydrocarbons will certainly be less important from the standpoint of gas consumption, although they may be very important in the general economy from the standpoint of the uses to which the products are put.

Chemical Uses May Conserve Gas

It might be suggested that chemical utilization may conserve gas which would otherwise be lost or wasted. Insofar as the manufacture of strictly chemical products may be concerned, this could only be the case if relatively inexpensive manufacturing equipment can be used, if the cost of processing is quite low, and if the volume of gas required for a manufacturing plant is small. A simple oxidation process which produces a saleable liquid product and otherwise meets these qualifications might be helpful from a conservation standpoint; research to develop such a process would be required.

This discussion of strictly chemical uses of natural gas will be concluded by mention of another avenue of approach. It was pointed out above that synthetic ammonia is being made from hydrogen produced from natural gas by a process which involves the intermediate production of a mixture of hydrogen and carbon monoxide. Hydrogen and carbon monoxide can be used as the raw material for synthetic production of methanol as well as higher alcohols, and a large part of the methanol now produced is made from a mixture of hydrogen and carbon monoxide which is made, however, in water gas machines.

It has already been suggested that when the demand for synthetic ammonia decreases, part of the synthetic ammonia capacity will be turned to the production of synthetic methanol since the plant requirements are in some ways very similar. It is therefore possible to look forward to competition within that portion of the synthetic methanol industry based on natural gas, with oxidation of natural gas being used to produce methanol directly in some plants, while in other plants natural gas will be used as raw material from which to produce a mixture of hydrogen and carbon monoxide from which methanol will be produced.

Fischer-Tropsch Process

In the production of synthetic methanol from a carbon monoxide-hydrogen mixture it is necessary to use quite high pressures. In studying the effect of pressure changes on this reaction, it was discovered that liquid hydrocarbons could be produced at lower pressures. This was the starting point of the Fischer-Tropsch process which has aroused so much interest in recent years. This process offers a means of converting natural gas into liquid hydrocarbons suitable for motor fuel and thereby a market which could absorb the entire natural gas production. A complete discussion of the Fischer-Tropsch process is outside the scope of this report, but it may be pointed out that if improvements thought probable by the more optimistic workers in this field should be realized, natural gas would become a more economical source of motor fuel than petroleum. This process therefore deserves careful watching by those engaged in the natural gas industry.

The attempt has been made to point out those ways in which natural gas is used in addition to its principal use as a fuel and source of energy. The greatest weight has been placed on those uses which take the greatest volumes of natural gas and other uses have been mentioned rather briefly. It has been pointed out that the present principal uses as a group will probably not consume as much natural gas in peace-time as they do at the war-time peak, that the minor uses will probably increase but cannot conceivably increase enough to become really important from the standpoint of natural gas consumption, and that chemical utilization by presently known processes cannot be considered as a means to reduce waste of natural gas, though further research may lead to a process applicable to gas which would otherwise be wasted.

Finally, attention has been directed to the Fischer-Tropsch process which can be used to make motor fuel from natural gas and which therefore presents the possibility of a market for natural gas which is a fuel market, but which involves chemical processing, and which deserves careful study because it may develop into a major use for natural gas.

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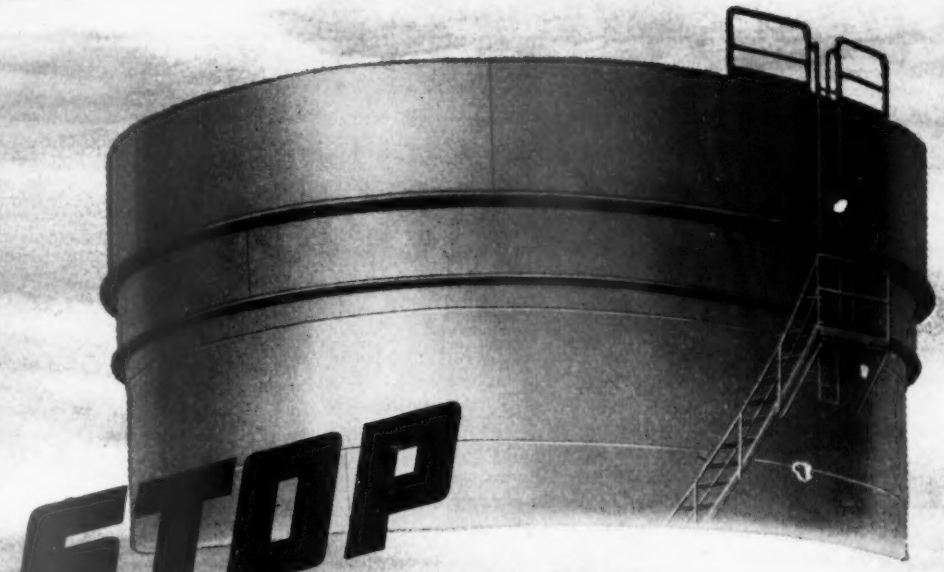

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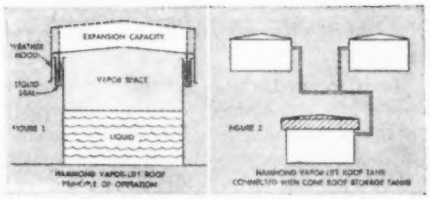

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INDUSTRIAL LUBRICATION

By W. G. Forbes

2—Lubrication of Steam Turbines

Technological developments in industrial lubricants and in their application to industrial processing are reviewed in this regular feature of NPN's Technical Section. While opinions expressed are solely those of the author, comment and questions from readers are invited. W. G. Forbes, lubricating Engineer for Tide Water Associated Oil Co., New York, is author of the well known books "Lubrication of Industrial and Marine Machinery" and "Lubricants and Cutting Oils for Machine Tools".

Q—Why are comparatively light bodied oils employed to lubricate turbine bearings, including the teeth of gear wheels when the turbine is coupled to a reduction gear?

A—Turbines operate at high speed, generally 1500 or 3600 RPM, and at these speeds there is a tremendous driving force on the oil film which lifts the turbine rotor weighing many tons, and maintains it in a floating position on the bearings as long as the turbine is in operation. The same hydraulic effect is produced on the face of gear teeth only in a different manner. Here the oil film is easily maintained because the contact areas are out of mesh before the oil film can escape. Thus a continuous oil film is maintained between the teeth.

Assuming the turbine shaft to be 8 in. in diameter and turning 3600 RPM the surface speed of the shaft is about 7500 feet per minute, and at velocities of this order only a light oil is capable of following the shaft into the bearing. If the oil is too heavy, it simply drags behind, and overheats, by producing an excessive amount of fluid friction within its own molecular structure as it follows the shaft around the bearing.

For turbines directly connected to a generator, the normal recommendation is a light oil having a Saybolt viscosity reading of 150 sec. at 100° F. This is below the rating of an SAE 10 oil and might be termed a heavy spindle oil.

For turbines coupled to a single reduction gear and using a common oiling system for gears and bearings, the normal recommendation is an oil having a Saybolt viscosity of about 300 to 400 sec. at 100° F. (SAE 20).

For turbines coupled to a double reduction gear and using a common oiling system for both gears and bearings, the normal recommendation is an oil having a Saybolt viscosity of 400 to 550 sec. maximum at 100° F. (SAE 30).

Q—Why is the oil in a turbine system generally maintained at a temperature below 140° F.?

A—The temperature of 140° F. is generally accepted as being the "critical temperature" for mineral oils. This means that as long as the temperature of the turbine oil is maintained below 140° F. the oil will not combine readily with oxygen from the air to form sludge. However, if the operating temperature is raised, the process of oxidation becomes more pronounced, and for every rise in temperature of 15° above 140° F. the useful life of an oil charge is just about cut in half.

This rapid acceleration of the oxidation process is not so pronounced for the very heavy oils, such as cylinder oils, but for oils having a viscosity rating of SAE 10, 20, 30 and 40, an operating temperature above 200° F. will reduce the life of an oil charge to a matter of hours. To graphically illustrate just what this means, it is generally assumed that the oil in an automobile engine has a service life of about 1000 to 2000 miles, more or less; if the average driving speed is taken as 40 miles an hour, the useful life of the oil charge is a mere 50 hours or so, which includes the benefit of new make-up oil added as required.

In a steam turbine system, the useful life of the oil charge may be measured in terms of years because 50,000 hours of service is quite common. Thus the charge of oil in a turbine system will last 1000 times longer than the charge in an automobile engine.

Q—What methods are generally used to filter the oil in the circulating systems of steam turbines?

A—The most common method is to use a centrifuge. This device eliminates sludge and water very effectively and takes up very little space. Other methods are also used, such as settling tanks, which allows water to settle out, and cloth strainers, etc., which filter out the sludge.

Q—What causes the internal parts of new turbines to rust, particularly after the first few days of operation?

A—New turbine oils have a high surface tension which prevents them from easily coating metal surfaces. They lack wetting ability, particularly when the metal surfaces are also new. It is sometimes difficult to understand how parts made of steel and iron can rust when they are immersed in oil, but new oil is easily displaced by water, and since water greatly accelerates the process of rusting, it has no difficulty in attacking the new metal surfaces despite the presence of the oil.

Water seeps into turbine oiling systems from the steam sealing glands which surround the turbine shaft and, since this entrance of seepage cannot be entirely prevented, it becomes necessary to introduce properties that will enable the oil to coat the metal surfaces to the exclusion of the water. This is accomplished by adding an anti-rust compound to the new oil. These agents are many and varied, but they all accomplish the same purpose, namely that of engaging in a mild chemical reaction on the surface of new iron and steel parts, which in turn renders them passive by forming a protective coating that repels water but not oil.

When this problem was first tackled by investigators it was originally solved by charging new turbines with used oil, or by adding about 20% of used oil to the new oil. The reason for the success of this method was due to the fact that all mineral oils develop mild "acidic materials" as they oxidize and age with service, and while the percentage is small in the average used oil, it has definite rust inhibiting qualities which also lower the surface tension of the oil. Thus a material of this type gives protection against rusting.

The anti-rust agents now used are added directly to the new oil in very small quantity and rust-inhibited turbine oils may be used continuously thereafter or not, depending upon the preference of the operating personnel. Once the new and active metal surfaces have been coated and passified, they seldom exhibit further rusting tendencies as long as they remain in continual contact with oil.

Q—What is the purpose of an anti-oxidant in turbine oils?

A—All mineral oils deteriorate as they age with service because they tend to combine with oxygen from the air. This action is greatly hastened by the influence of heat, and as the temperature is raised the charge also becomes more and more susceptible to the catalytic influence of metals, which further accelerates the process of deterioration. The results of these chemical actions are evidenced by the generation of acidic compounds and

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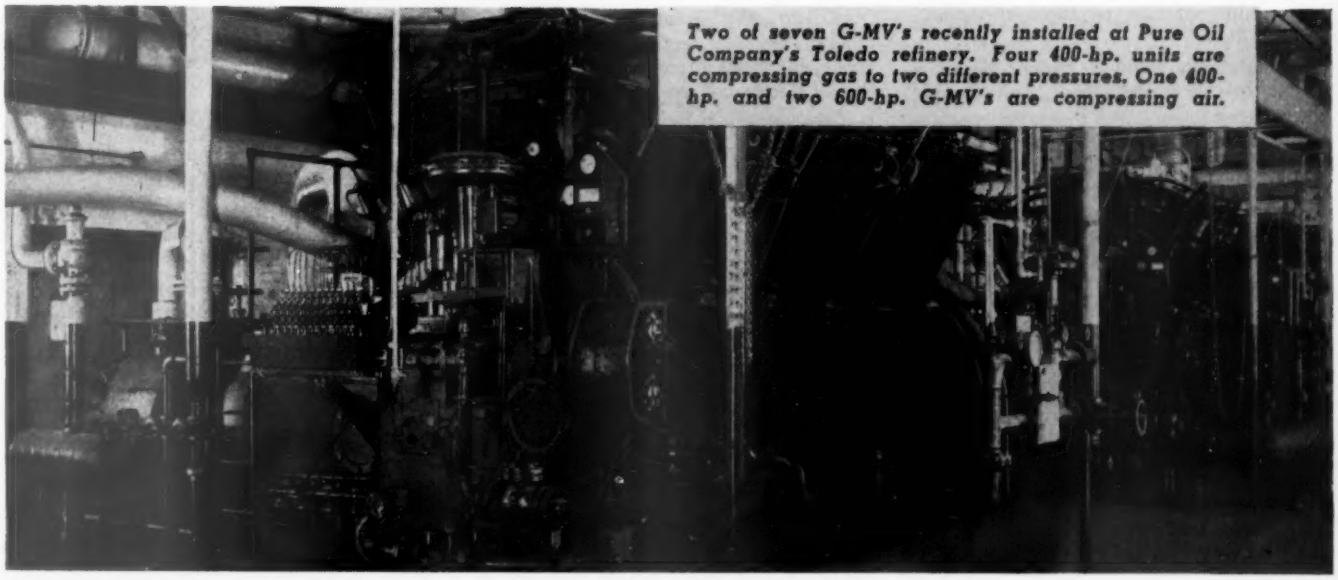

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oxidized oil, which latter material is conveniently termed "sludge." This is the stuff that collects in the bowls of centrifuges or on the surfaces of filters.

Nature seems to have fortified all crudes against any natural process of oxidation by adding sulfur in a variety of compounds, and all mineral lubricating oils contain a small percentage of these sulfur compounds after completion of the refining process. However, at temperatures much above 140° F. or so, these sulfur compounds lose much of their protective influence, and this fact has led to a tremendous amount of research work to find anti-oxidants that will improve upon nature and endow mineral oils with greater resistance to the influence of higher temperatures.

At the present time most turbine oils contain an anti-oxidant, particularly the lighter bodied grades, which respond more readily to their influence; as a result, these additive agents have been responsible for extending the service life of light turbine oils by a general average of several thousand hours. They appear to impart their resistive properties by shielding the oil molecules from the influence of oxygen and catalytic actions, while at the same time slowly sacrificing themselves in the process. During the past few years, several hundred patents have been issued on chemical formulas for anti-oxidants. A discussion of their many variations would be impractical, but in general they come under the chemical headings of amine compounds, nitrogen compounds, phenols, sulfur compounds, phosphorous compounds, etc. Thus there are many compounds which possess anti-oxidation properties.

Q—How much clearance is required between a turbine shaft and bearing to allow for metal expansion and the formation of an oil film?

A—The general estimate is roughly one thousandth of an inch clearance for each inch in diameter of the shaft, plus an additional one to three thousandth of an inch.

This rough estimate cannot be relied upon for all applications. For example, it does not mean that a 2-in. shaft requires only three thousandths of an inch clearance. It requires more, but an 8-in. shaft turning 1500 to 3600 RPM requires about 10 to 12 thousandths of an inch clearance, while a 6-in. shaft turning at the same speeds would require about eight thousandths of an inch clearance.

When a shaft turns 10,000 RPM it requires considerably more clearance. For example, if an 8 in. diameter shaft turns 10,000 RPM it would probably require about 22 thousandths of an inch clearance against about 12 thousandths at 3600 RPM. This is because the higher speed of rotation draws considerably more oil into the pressure area of the bearing which automatically takes care of the greater escape losses from the sides of the bearing and the greater amount of frictional heat developed within the oil film as a result of the high speed.

The automatic balance of oil film maintenance has to be adjusted in two ways, by the use of a light bodied, quick acting oil, and by maintaining a large volume of oil in the clearance space to act as a reservoir. Otherwise, the shaft may pull away more oil than is maintained at all times in the clearance space and the bearing may be destroyed.

Oil pressure alone in the supply line will not always compensate for the reservoir effect that is required in large bearings operating at high rotational speeds, and only a light oil will follow the shaft without producing oil drag and unnecessary overheating. This is because an oil that is too heavy will develop and maintain an excessive amount of fluid friction within the oil film.

Q—Why are large turbines kept running year in and year out without stopping even when they are carrying no load or only a small load? What effect does this have on the bearings?

A—Large turbines are kept in operation as long as possible to avoid the metal expansion difficulties which occur when starting and stopping. Large turbines require a warming up period of several hours and while this might seem to be a simple operation, it is actually a very delicate operation and therefore avoided. For this reason central power stations may run their turbines for several years without stopping and turbine propelled ships keep the main turbine running while loading and unloading cargo in ports of call.

This procedure is highly beneficial for the main bearings because the period of starting and stopping has a critical influence on bearing wear. When the surface speed of the shaft starts to fall below 100 feet per minute and on down to zero, the oil film starts to weaken because it relies on the driving force of the rotating shaft to maintain itself. When the turbine starts from rest, the situation is even more critical because actual metal contact occurs for at least a moment or two until the oil film builds up and floats the shaft.

This action can be responsible for considerable wear and tear on the surface of the bearings. In actual practice, a turbine may run for several years and show practically no bearing wear as long as it does not stop. This is a good illustration of the fact that most bearing wear occurs at the starting period, and machines that start and stop frequently run into much more trouble from this source than machines that run continuously for long periods of time.

Q—What pressure per square inch is normally carried on the load area of turbine bearings?

A—In the pressure area of a turbine bearing the normal load is 50 to 150 psi. of projected surface depending upon the size of the turbine. Hence, the heavier the rotor, the longer the bearing to secure this distribution of pressure. Turbine designers are not limited for room space, and therefore design their bearings to carry low unit pressures. Obviously the practice is beneficial.

Q—Why do oil cooler tubes become coated with oxidized oil or sludge, and what precautions should be taken when cleaning these tubes?

A—Oil cooling tubes are made of brass or similar type of copper alloy to secure maximum heat transfer between the cold water which passes through the inside of the tubes and the warm oil which passes over the outside. Since the tubes are comparatively cold, they tend to condense the products of oil oxidation on their surface and this coating builds up with time and reduces heat removal from the oil. Hence it is generally necessary to remove this coating about once a year.

The proper way to clean a bundle of oil cooling tubes is to remove the bundle and place it in a tub of boiling water containing a suitable cleaning compound. These soap compounds may be of the home made variety but it is generally better to purchase this material from companies specializing in their manufacture. After washing the tubes with a final rinse of fresh water, they may be replaced without running any chance of future complications from soap compounds washing into the oiling system.

Several cases of troublesome emulsions in turbine oiling systems have occurred as a result of soap compounds getting into the system. This type of contamination is not easy to eliminate because only a small amount of soap and water is required to produce an emulsion and the oil charge may have to be removed two or three times before the system is cleared. If enough soap gets into the system, the only cure is to dismantle the system and wash everything out with hot water and steam.

Q—Why are metals such as copper and brass used very sparingly in turbine oiling systems?

A—Metals such as copper and its alloys have a definite catalytic influence on mineral oils which hastens the oxidation or sludging process. Zinc is even a worse offender in this connection and, therefore, the inside of oil tanks should never be galvanized.

Metals such as iron and steel and stainless steel alloys are used in turbine oiling systems to the exclusion of all other metals. About the only parts made of other metals are the oil cooling tubes, which are generally made of brass to secure the benefit of the heat transfer properties peculiar to copper. Fortunately, these tubes quickly take on a thin coating of oxidized oil which renders them more passive thereafter and materially cuts down their catalytic tendencies on the charge in the system.

The TCC Catalytic Cracking Process For Motor Gasoline Production

By R. H. Newton, G. S. Dunham and T. P. Simpson

Engineering improvements which have been made in the Thermofor Catalytic Cracking process are described in detail. These include means for insuring uniform contact of the catalyst with the reacting vapors, isolation of the reaction and regeneration systems, maintenance of thermal balance by addition and removal of heat, and instrumentation and control for convenient and safe operation. The factors governing rate of flow of pellet catalyst in beds and methods of insuring uniform flow and distribution have been studied experimentally in plant-scale models.

The characteristics of the cracking catalyst require a minimum temperature of about 900°F. to burn off the coke deposit in order to regenerate the catalyst, and also dictate a maximum temperature of not over 1150°F. in order not to damage the catalyst. These requirements are satisfied by stepwise burning and cooling and limiting the temperature in any zone by control of the oxygen supplied.

THE catalytic cracking of petroleum fractions has permitted the production of vast quantities of gasoline of higher octane rating than other processes which would produce the same volume of gasoline. The development and acceptance of catalytic cracking has been rapid and, of course, has been spurred on by the war. The first commercial plant employed the Houdry fixed bed process and was placed in initial operation at Paulsboro, N. J., in 1936.

The gradually rising octane standard for automotive gasoline, as a result of keen competition and a consumer market that is extremely sensitive to slight variations in octane number, has forced the replacement of thermal cracking, which produces 65-70 octane gasoline, with catalytic cracking making 80 octane or higher.

During the war, the high octane base stocks produced by catalytic cracking are of tremendous importance in meeting our needs for 100 octane aviation fuel; but at the conclusion of hostilities the demand for such fuel will decrease, and most of the high octane components will find their way into motor gasolines of greatly improved quality than those heretofore available.

Inasmuch as the octane number of all regular grade gasolines must meet the minimum of consumer demand, and since present catalytic cracking facilities are concentrated in a limited number of refineries, it is expected that the installation of more facilities will continue after the war in order to balance the production at those plants not now having catalytic cracking equipment.

In general, in the Houdry and TCC catalytic cracking processes, a stream of vaporized oil is passed through a bed of cracking catalyst which breaks down the heavier molecules. The catalysts currently in use are pellets of activated natural clay or synthetic pellets and beads of the silica-alumina type. The products of cracking are light gases, commonly referred to as propane and lighter; a B-B fraction consisting essentially of iso-butane and butylene; a gasoline cut consisting of iso-paraffins, aromatics, and lesser amounts of olefins and naphthenes; a gas oil cut which is richer in aromatics than the virgin gas oil; and a carbon deposit on the catalyst. The proportions of these materials and their compositions vary with operating conditions.

It might be noted that the high quality of the cracked gasoline is largely due to the presence of iso-paraffins and the absence of normal paraffins as well as to the character of the olefins present. The deposit of carbon on the catalyst requires a regeneration with air to remove it and present a fresh catalyst to the oil.

As mentioned before, the first commercial catalytic cracking units employed the Houdry fixed bed principle. These plants, now numbering about 30, demonstrated the technical feasibility and economic advantages of catalytic cracking.

During the development and commercialization of the fixed bed units, the Socony-Vacuum Oil Co., Inc. instituted research on the design of a unit employing the moving catalyst principle, and carried this program through to the successful installation and operation of 34 commercial units. Today Houdry Process Corp. offers for licensing these two processes employing the same basic principles but differing in application. The engineering development in both processes is well advanced and assures a minimum of operating difficulties. Simpson, et al[1], have given a description of the process features for the TCC cracking process for production of aviation gasoline.

The TCC Process

A schematic flowsheet of a TCC unit is given in Fig. 1. The TCC unit consists of two vessels, one a reactor in which oil passes through a bed of catalyst from 8 to 35 ft. in depth. The catalyst bed is moved downward at a uniform rate and removed at the bottom, whence it is transported in a bucket-elevator to the second vessel or regenerator. As in the reactor, the catalyst moves downward at a uniform rate, but is passed through a series of alternate burning and cooling zones; air is admitted to and fumes removed from each burning zone, and, between the burning zones, the catalyst is cooled by generation of steam in cooling coils.

The reactor vessel is extremely simple and normally employs the principle of counter-flow wherein clean catalyst is first contacted with partially cracked and the more refractory oil, leaving the initial cracking, which is easily accomplished, on the partially spent catalyst. The use of a solid bed of cracking catalyst insures good distribution of oil throughout the catalyst.

There are a number of distinctive chemical engineering features of the process, which required careful laboratory study in establishing the proper design. The size of catalyst particle chosen was 0.1 to 0.2 in. in diameter and was determined as sufficiently large to be conveniently manufactured, and of proper size to permit ready flow of vapors through a bed, and at the same time permit proper diffusion into the individual particles. The problem of handling such material and distribution of flow, both of solid and of vapors, received a great deal of attention. The over-all design of commercial sized plants showed elevators of about 200 ft. lift to be necessary. Such elevators operating as a single lift for transporting catalyst at 900-1000° F. were designed through cooperation of the Jeffry Manufacturing Co., Lummus Co. and Socony-Vacuum Oil Co., Inc.

Operating experience to date (over a year) has been very satisfactory. To insure smooth vertical downward movement of catalyst, the rate of flow of oil vapors through the bed must be controlled below that point where "boiling"

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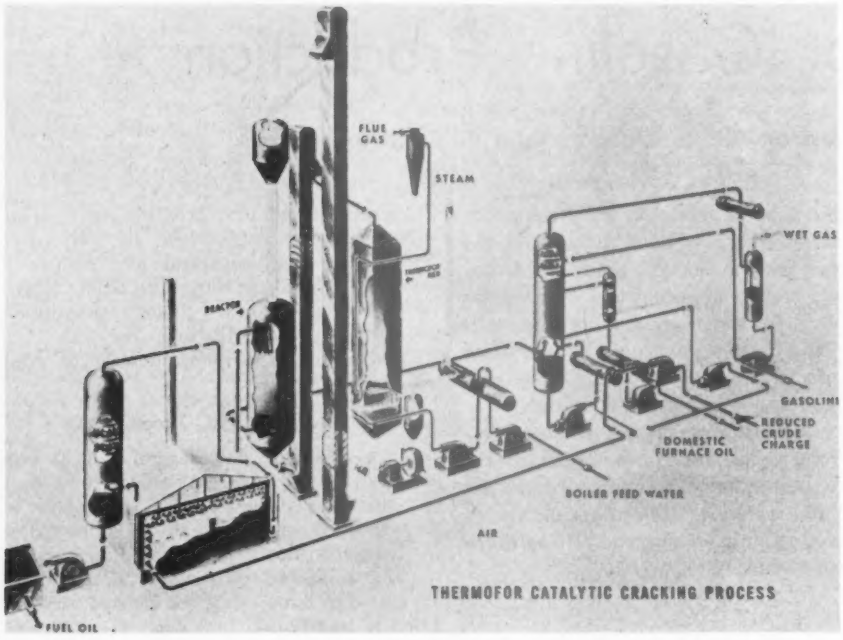

Fig. 1—Schematic flow diagram of the TCC catalytic cracking process

begins. In practice the maximum permissible pressure drop is somewhat less than the weight of catalyst. The pressure drop through beds of catalyst is found to agree well with the data published by Chilton and Colburn[2], when corrected for average inlet and outlet conditions. Obviously, the lifting or boiling effect is most pronounced where the oil vapor leaves the catalyst, since the molecular weight is the lowest at this point. The pressure drop through a deep bed is of considerable help in producing uniform flow throughout the bed; however it is generally felt that provision for uniform distribution should be made at the inlet and outlet points.

Another engineering factor of considerable interest is the distribution of flow of catalyst particles to insure vertical movement of the bed. Laboratory experiments were made to determine not only the rate of catalyst flow through various openings, but also the type of flow. It was found that when there was a single opening in the center of a vertical cylindrical vessel, 24 in. in diameter or less, the flow of catalyst was vertical whenever the depth of bed exceeded 1.5 times the diameter of the vessel. At the lower depths, appreciable coning occurred, and there was visible cross-flow of catalyst. This condition necessitated that a bed depth of at least 1.5 times the spacing of the distributor holes be allowed above the flow control plate.

The type of flow observed in these experiments was extremely interesting and is illustrated in Fig. 2. The diagram shows several successive positions of the surface of the pellets. When the depth exceeds 1.5 times the diameter of the container, the surface is horizontal and moves downward uniformly. If the bed depth exceeds 1.5 times the diameter, the material outside a cone of included angle 38° is substantially stagnant. The apparent angle of repose is 71°, as compared to the static measurement of 34°.

As the level of the catalyst drops, a cone appears in the center, the diameter of which is approximately determined by the apparent 71° angle of repose. Outside of this point the surface remains level by a horizontal motion of the catalyst particles. At an average height between one-half and one diameter, the exterior part of the cone assumes a static angle of repose of 34°, and the motion

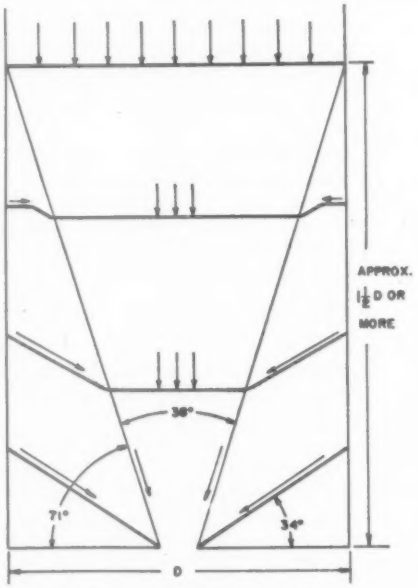

Fig. 2—Diagram of catalyst flow, showing the direction of movement for several successive positions of the surface of the pellets. To obtain uniform downward flow, experiments have indicated an optimum bed depth of at least 1.5 times the diameter of the vessel

is parallel to the surface. As before, the area within the 71° apparent angle of repose moves substantially vertically downward.

The rate of flow of catalyst from any orifice is generally restricted by the catalyst below, but it was essential to know the limiting maximum rate of flow. The following equation was found to express the experimental data:

$$F = 8.50\ D^{2.96}\ H^{0.04}$$

or

$$f = 10.8\ D^{0.96}\ H^{0.04}$$

where F = catalyst flow in lbs. per min.
D = diameter of orifice in in.
H = head in ft., and
f = catalyst flow in lbs./min./sq. inch.

This relationship is unique as far as is known. It shows that head has almost no effect, whereas the flow is directly affected by the diameter of the hole as well as its area. This formula holds where the diameter of the hole is greater than 6 times the particle diameter. Below this diameter, flow is very irregular. A plot of the experimental data is given in Fig. 3.

In order to check these flow experiments, transparent models were made to full commercial dimensions, and the catalyst flow carefully observed by use of multi-colored pellets. This allowed considerable assurance that the methods of control of catalyst flow were sound.

In the regeneration phase, it is essential to maintain a given minimum temperature to insure the initiation of combustion, and also to limit the maximum temperature to about 1150° F. to prevent excessively rapid deterioration of the catalyst. The present design calls for alternate burning and cooling zones to accomplish these aims.

The rate of combustion of the carbon deposit on catalyst pellets has been studied carefully for the various types of regenerating equipment. The utilization of air is shown in Fig. 4 as a function of carbon burned. When air is first passed through a bed of catalyst, the oxygen in the air is substantially completely consumed. This condition persists until about one third of the carbon is burned, then the oxygen concentration rises with a decreasing rate of combustion. When about 70% of the carbon has been burned, the rate of combustion is relatively slow, and the carbon remaining is completely cleaned up by a longer exposure.

Thus the rate of combustion in the upper portions of the kiln is determined largely by the rate at which air is furnished to each section. In the center sections, the air is incompletely utilized, and in order to make the best use of it, it is essential that the temperature of the catalyst be as high as possible within the limits set by catalyst stability. The lower sections provide a sufficient holding time in accord with the description of combustion given above.

The amount of carbon that can be

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ISOCEL, a granular aluminum chloride catalyst employing a selected grade of activated bauxite as carrier, overcomes the difficulties usually encountered when aluminum chloride is used alone or in sludge form.

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6. **Alkylation of aromatic hydrocarbons.**
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Many reactions have been studied in each field. A number of these have been the bases for such commercial developments as cracking petroleum hydrocarbons, the isomerization of n-butane with ISOCEL, and the condensation of chlorinated paraffins in the presence of aluminum chloride for the production of pour-point depressants. Many others indicate the possibility of commercial adoption.

Reactions conducted in the vapor phase lend themselves especially to efficient catalyzation with ISOCEL. Corrosion of reaction vessels is greatly reduced.

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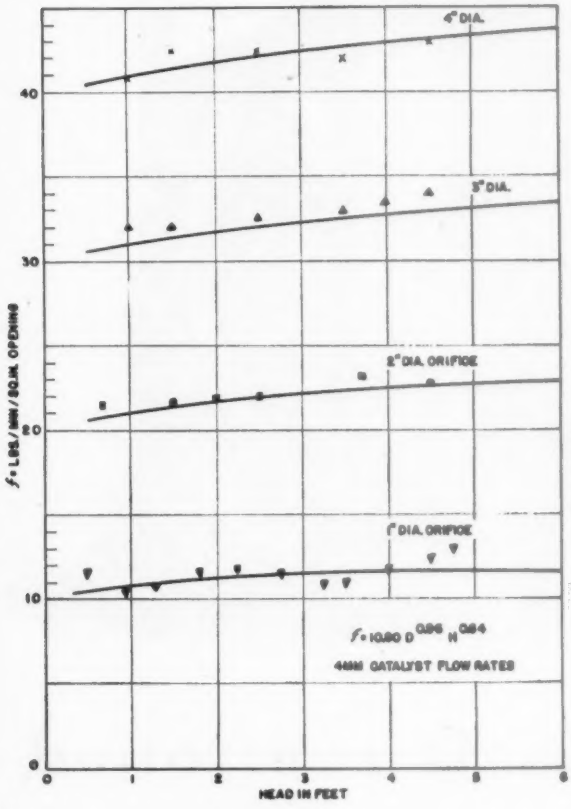

Fig. 3—Rate of catalyst flow in lbs./min./sq. in. of opening for various bed depths and orifice diameters, using catalyst of 44 mm. diameter. Rate of flow is directly affected by the diameter of the opening through which the catalyst moves, rather than by the head of catalyst above the opening

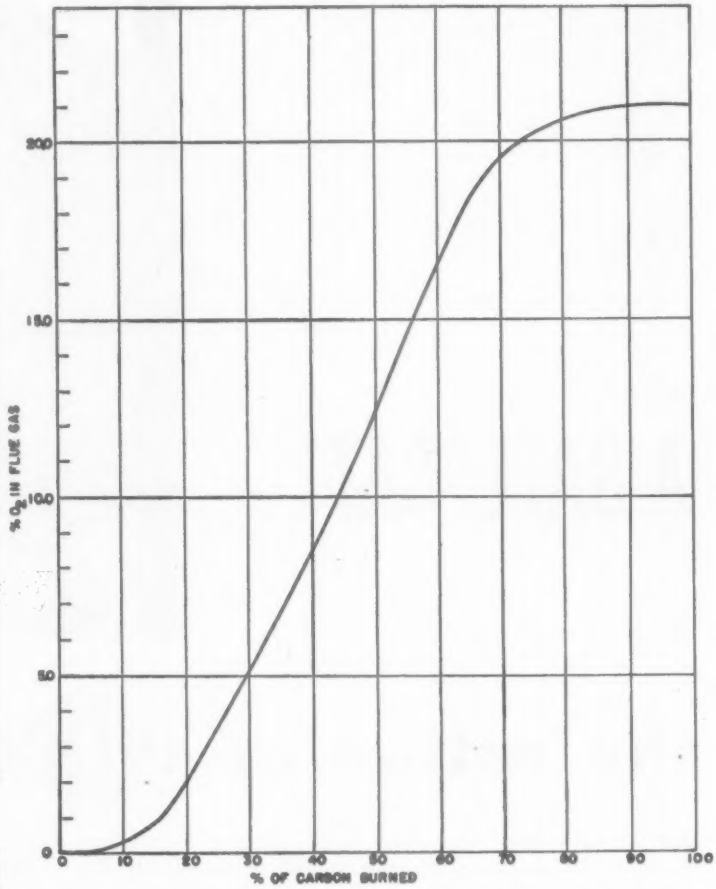

Fig. 4—Utilization of oxygen in the combustion of the carbon deposit on the catalyst at atmospheric pressure and a regeneration temperature of 1000°F.

burned in each combustion zone depends on the limits of inlet and outlet catalyst temperature for each zone. For a plant having a catalyst circulation of 100 tons/hr., it is possible to remove 5,000,000 BTU/hr. from each section by allowing the catalyst temperature to rise 100° F. If no heat is removed by the air stream, this corresponds to a combustion rate of 357 lb./hr. of carbon in the section. However, it is preferable to use cold regeneration air in the upper zones where combustion is rapid. The additional heat removed in heating this air from atmospheric amounts to about 1,500,000 BTU/hr., so that 30% more carbon can be burned, making a total of 464 lb./hr. per section. Presently, operating kilns have from 7 to 10 burning sections.

Another factor of considerable importance in the operation of the TCC unit is the isolation of the oil system from the air by means of pressure seals of inert gas. It is a well known fact that a pressure differential can be maintained across a pipe full of catalyst particles by maintaining a flow of gas through it. This is exactly the principle employed in sealing the top and bottom of the reactor.

The top and bottom differ, however, in that at the top, the flow of sealing gas and catalyst are counter-current, and in order not to stop the downward flow of catalyst, the gas flow must not exceed that giving a pressure drop of about 6 in. of water per foot of height. This allowable minimum pressure drop is about 70% of the weight of catalyst per foot of height. In laboratory studies, the flow of catalyst in a smooth container is not ordinarily interrupted by a flow of gas until the pressure drop equals or exceeds the weight of catalysts. However, once the flow is stopped or "bridging" has occurred, the pressure drop must be decreased appreciably to re-establish flow. The use of a maximum figure of 70% of the weight for allowable pressure drop permits a factor of safety to take care of gas surges, and, except in very unusual circumstances, allows the catalyst flow to re-establish itself when the pressure surge subsides.

As mentioned before, this pressure drop may be calculated with sufficient accuracy from the data of Chilton and Colburn[2]. In modified form and applied to gas flow in the turbulent region through TCC clay catalyst this is:

$$\frac{\triangle P}{\triangle L}\rho = \frac{1}{2{,}040{,}000} G^{1.64}$$

where $\triangle P/\triangle L$ is pressure drop in lbs./sq.in./ft. of length, ρ is vapor density in lbs./cu. ft., and G is superficial mass velocity of vapor in lbs./hr./sq. ft.

The data on air, flue gas, and hydrocarbon vapors appear to fit this relationship. A plot of this equation, together with typical data points from plant operations is given in Fig. 5.

For the accuracy required in these calculations, the viscosity of the gas can be neglected, due to the low power to which Z occurs in the turbulent region. The data apply to values of $D_\rho G_a/Z$ greater than 0.3 where D_ρ is the diameter of the particle in inches, G_a the rate of flow in pounds per square foot per second, and Z the viscosity in centipoises.

An over-all heat balance for the operation of both reactor and kiln is given in Table 1. There are still several factors of the heat balance on commercial units that are under investigation since they are not clearly understood. These data were obtained from a commercial plant of somewhat different internal design than the one discussed. However, it serves to show the magnitude of quantities of heat being considered. In the reactor, the heat of reaction, which is endothermic, is furnished from two major sources —heat in the entering oil vapors, and heat of hydration of the catalyst by steam.

In a counter-current flow system, when

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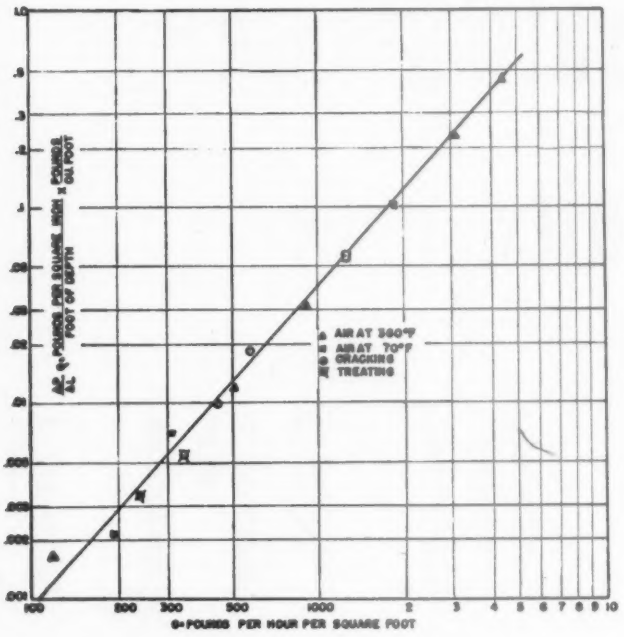

Fig. 5—Plot of equation for pressure drop across a TCC catalyst bed with typical data points from plant operations

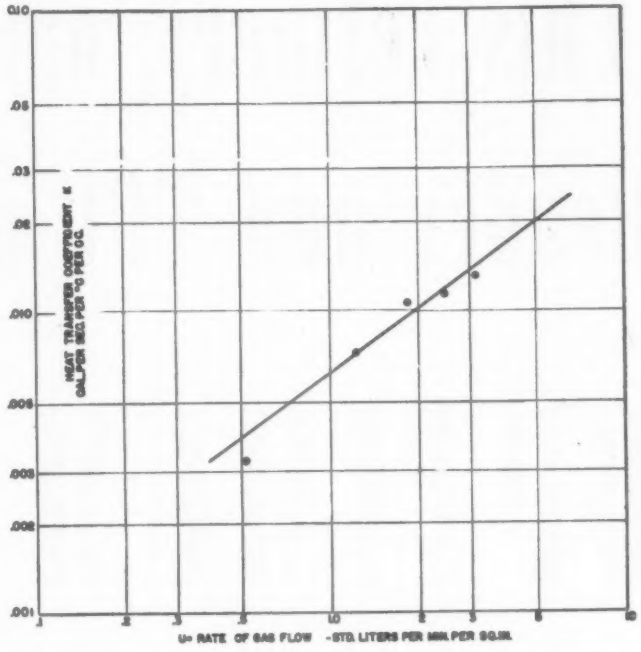

Fig. 6—Plot of coefficient for heat transfer from gas to pellet catalyst against rate of gas flow

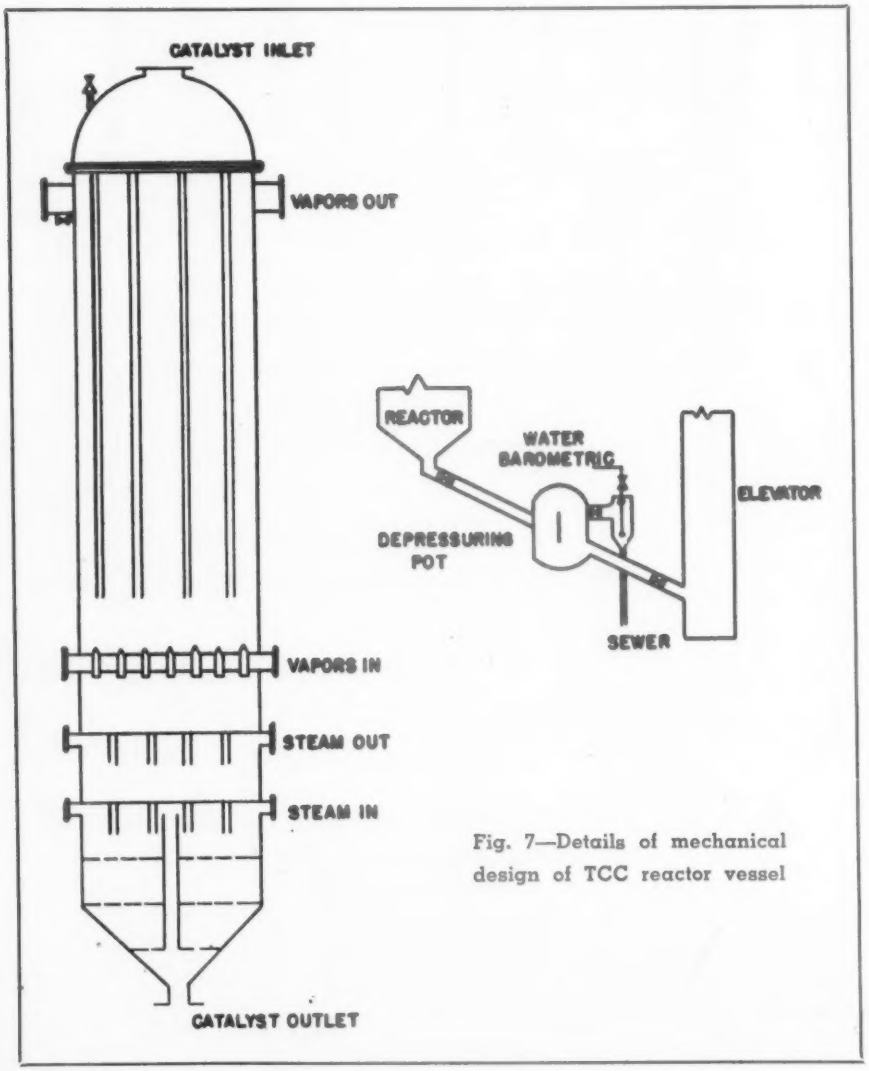

Fig. 7—Details of mechanical design of TCC reactor vessel

the ratio of catalyst flow to oil flow is 2.0 or less, the temperature at which the catalyst enters the reactor has relatively little effect on the temperature of reaction, since heat is transferred from catalyst to gas extremely rapidly. In effect, raising the inlet catalyst temperature merely increases the temperature of the outgoing cracked oil vapors without any major effect on the reaction temperature.

Numerous studies of the heat transfer from gas to pellet catalyst have been made. A precise mathematical use of these data has been very difficult. However, it may be stated that the heat transfer is extremely rapid and is in general agreement with published results of similar studies. Following the correlation method adopted by Furnas[3], the coefficient for heat transfer from gas to catalyst was found to vary from 0.003 to 0.013 cal./sec./°C./cc., and the "material coefficient" A was found to be 0.05, which is well within the limits for various substances. Fig. 6 shows the experimental data together with a curve calculated from Furnas' data using $A = 0.05$. The only condition at which an appreciable difference between the temperature of the catalyst and hydrocarbon vapors can exist is at a location where the temperature gradient along the height is very steep.

It is interesting to note that the data in Table 1 show the absorption of 830 lb./hr. of water by the catalyst, amounting to about 1/2% of its weight. The specific heat of reaction for cracking varies widely for different operating conditions over the range of 90 to 200 BTU/lb. of light products made. The figure used in the example is an average figure and gives the heat of ab-

sorption of water vapor as 1580 BTU/lb. Obviously these two figures can be adjusted somewhat without affecting the heat balance.

It should be mentioned again that these data are subject to the errors of commercial measurement, and are at present the subject of additional study.

The heat balance on the kiln shows the endothermic heat of desorption which is an aid in control of temperature in the top sections. The figure shown for steam generated is the actual measured production. Apparently there is some as yet unknown heat loss in the system at this plant or the steam generation figure is in error.

Due to its complexity, the actual sectional heat balance for the kiln is not given, but the operating conditions, section by section, are shown in Table 2. Actual air flows and steam production figures for each section are unknown, but it is evident that the temperature rise on burning is a function of air distribution, and the temperature fall on cooling is a function of the number of cooling coils in service.

Mechanical Design of Reactor

The cracking plant itself is simple in design and operation. The heaters, coolers, distillation equipment and gas plant are conventional and common to many operations in petroleum refineries. The reactor vessel, shown in Fig. 7, is unique in the distribution of the oil vapors, the means of sealing the top and bottom, the catalyst flow control system at the bottom, and the purge system.

The clean regenerated catalyst is introduced into the reactor through a vertical leg, which provides sufficient head of catalyst to flow into the unit against the operating pressure.

A top seal is provided by introducing flue gas into the catalyst distributing chamber under sufficient pressure to prevent hydrocarbon vapors from entering this zone and subsequently leaking out through the feed leg. The flue gas is generally prepared in an inert gas generator, in order to have the minimum oxygen content.

The distribution of catalyst over the catalyst bed is accomplished by a series of feed pipes, each covering about 10 sq. ft. of area. Uniform flow downward at this level is assured by the flow control system at the bottom of the vessel.

The oil distribution grid, shown schematically in Fig. 8, consists of inverted channels connected to an inlet duct passing along the diameter. The channels are constructed relatively narrow, so as not to impede catalyst flow, and at the same time deep enough to provide ade-

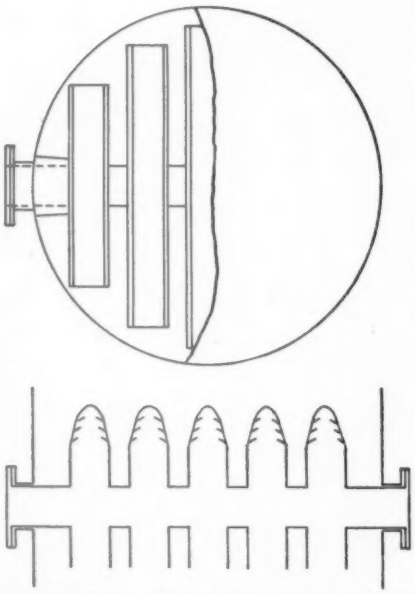

Fig. 8—Schematic sketch of the oil feed grid in the TCC reactor, which consists of inverted channels connected to an inlet duct. Louvers in the channel permit the incoming oil vapors to pass out and around the downward-flowing catalyst

TABLE 1—Typical TCC Operating Conditions and Heat Balance

OPERATING CONDITIONS

Charge Rate	8,751 b/d	
Gravity	31° API	
Oil and Steam to Reactor	935° F.	
Vapor Temp. from Reactor	950° F.	
Catalyst to Reactor	995° F.	
Catalyst from Reactor	875° F.	
Steam to Vaporizing Section		4,200 #/Hr.
Steam to Stripping Section		3,200 #/Hr.
Gas Products	6.7% Vol.	7,500 #/Hr.
BB Cut	9.4% Vol.— 6.1% Wt.	6,800 #/Hr.
Gasoline	40.8% Vol.—35.2% Wt.	39,400 #/Hr.
TOTAL CRACKED PRODUCTS		53,700 #/Hr.
Coke Produced		4,150 #/Hr.
Gas Oil		54,400 #/Hr.
Reactor Charge		112,250 #/Hr.
Adsorption of H_2O in Reactor		830 #/Hr.
Catalyst Circulation	106 Tons/Hr.	
Catalyst to Kiln	865° F.	
Catalyst from Kiln	1005° F.	
Steam Generation		21,100 #/Hr.
Air to Preheater 18,100 CFM @ 60° F.		86,600 #/Hr.
Air to Kiln preheated to	501° F.	
Air leaving kiln	978° F.	
Flue Gas Analysis	9.2% CO_2	
	6.6% O_2	
	4.0% CO	
	80.6% N_2	
	11.7% H_2O Vapor % Gas Vol.	

H/C ratio in coke = 0.59
CO_2/CO ratio in flue gas = 2.3

REACTOR HEAT BALANCE

	Input, BTU	Output, BTU
Catalyst	6,350,000	
H_2O Absorption	1,290,600	
Carbon on Catalyst	50,400	
Heat of Cracking		6,020,000
Oil Products		1,140,000
Steam		31,000
Heat Loss Est.		500,000
Totals	7,691,000	7,691,000

KILN HEAT BALANCE	**Input, BTU**	**Output, BTU**
Carbon Burned	64,800,000	
Catalyst		7,410,000
Desorption of H_2O		1,290,600
Temp. Inc. of Desorbed H_2O		47,000
Steam Generated		21,100,000
Est. Heat Loss		8,000,000
Air to Kiln		10,300,000
H_2O in Air to Kiln		418,000
H_2O Acc. Combustion		187,000
Accounted for		48,762,000
Unaccounted for		16,038,000
Totals	64,800,000	64,800,000

TABLE 2—Operating Conditions in TCC Kiln

Catalyst Temperatures				Burning		Cooling	
Burning Zone		Cooling Zone		Damper	Temp.	Coils	Temp.
Inlet	Outlet	Inlet	Outlet	Position	Rise, °F.	in use	fall °F.
915*	1005	1005	995	Wide open	90*	0	10
995	1040	1040	960	¾ open	45	2	80
960	1040	1040	975	Wide open	80	1	65
975	1065	1065	1020	Wide open	90	1	45
1020	1050	1050	1010	¾ open	30	1	40
1010	1070	1070	1025	Wide open	60	1	45
1025	1065	1065	1010	Wide open	40	1	55

* These values are only approximate.

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R-449

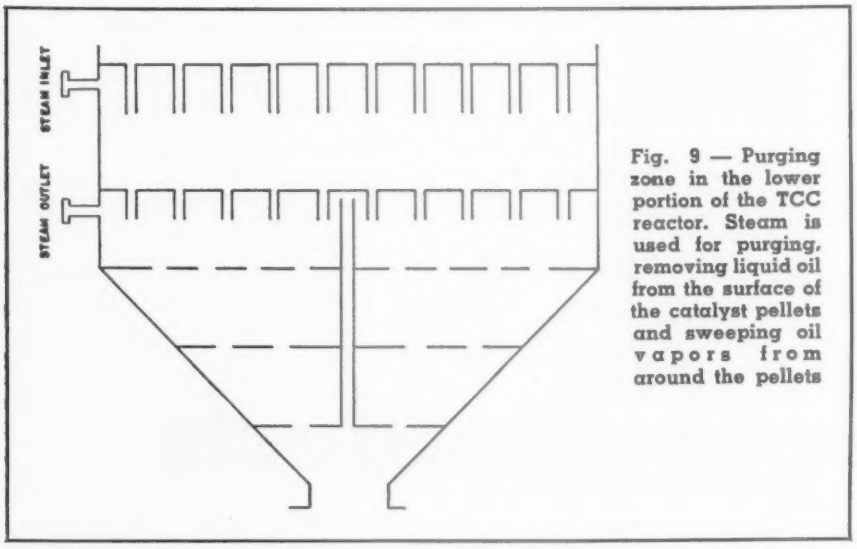

Fig. 9 — Purging zone in the lower portion of the TCC reactor. Steam is used for purging, removing liquid oil from the surface of the catalyst pellets and sweeping oil vapors from around the pellets

quate cross section to avoid excessive pressure drop along the channel.

The catalyst which passes over the feed grid is coated with a deposit of higher boiling constituents of oil, some of which have been converted to a dry coke. However, cracking is still progressing, and it is essential to decrease the concentration of carbonaceous matter on the catalyst as much as possible. Not only would it be wasteful to admit into the regeneration zone spent catalyst having liquid oil on its surface, but an additional burning load would be imposed on the kiln. Furthermore, recovery of the "purge oil" amounts to several per cent of usable liquid oil.

Purging is apparently composed of two steps: desorption of liquid oil from the catalyst, and sweeping of the oil vapors from around the catalyst particles. The time for purging is relatively short, and uniform distribution of steam through the catalyst is important.

The purge steam distribution system is combined with the upper flow plate of the catalyst flow control system, as shown in Fig. 9. This flow plate contains several concentric rings of holes each 4 ins. in diameter. The center to center distance along the circumference is short, and the distance between the pitch circles is about 18 in. which insures uniform catalyst flow at all points higher than about 27 in. above the plate. The catalyst collects beneath the plate according to its angle of repose leaving a vapor space for introducing the purge steam, and at the same time providing a seal and equalization of pressure across the cross section. This insures equal distribution of the purge steam to each of the 400 odd holes.

In some units, it is desirable to avoid steam in the active portion of the catalyst bed in order to obtain the greatest cracking severity. Hence, provision is made for collecting the steam and purge vapors in a grid of collecting channels of design similar to the oil distributing grid.

The catalyst flow plates have already been mentioned. In principle, the number of rings of holes is decreased at each succeeding lower plate. The center lines of the lower holes are midway between the two circles above. Thus, the lower ring of holes collects catalyst equally from each of the two rows above, permitting a decrease in diameter to a single catalyst outlet. See Fig. 9.

The catalyst leaving the reactor passes through a depressuring pot to allow the escape of steam, which is removed by a small jet condenser. Inspection of the condensate stream for traces of oil provides a convenient check on the completeness of purge.

The temperature conditions in the reactor are such that a simple cylindrical steel vessel can be used, and the insulation placed outside the shell. The vessel can be fabricated in accordance with the API-ASME code in all respects. For corrosive stocks the reactor is lined with the proper alloy steel. This is accomplished with the minimum expenditure of expensive alloy. The elimination of heat insulation from within the reactor avoids the difficulty frequently encountered in this construction of coke formation within any porous material with subsequent uncontrollably high temperatures in the event of air getting to the coke. This coke formation also tends to spall most refractories.

Kiln Design

The design of the kiln has evolved after many years of study of clay burning and is based on commercial experience with percolation clay regenerators. This work has been described by Simpson, et al[4]. Numerous improvements and simplifications have been incorporated. The major of these changes is the elimination of angle packing and replacement of the salt cooling system with direct steam generating coils.

A sketch of a recent kiln is shown in Fig. 10. The distribution and control of flow of catalyst in the kiln is handled by the same designs as used in the reactor. The kiln is of square cross section in order to facilitate the entrance of the cooling coils. It is lined inside with a suspended tile lining (Dietrich or Bigelow-Liptak). This construction has proved quite satisfactory, since the kiln operation is at substantially atmospheric pressure and the extensive use of buckstays on the flat walls is not required.

No sealing of the top of the kiln is required, since the escaping flue gas from the top section is substantially oxygen-free.

The details of one zone in the kiln are shown in Fig. 11. One air inlet is used with two collectors. The minimum air path is about 30 in., which provides a pressure drop of a few inches of water through the catalyst. In the lower zones, longer holding time and longer air path are provided. The air inlet duct extends across the kiln and the distributor channels extend from the duct to the wall. As in the case of the oil inlet

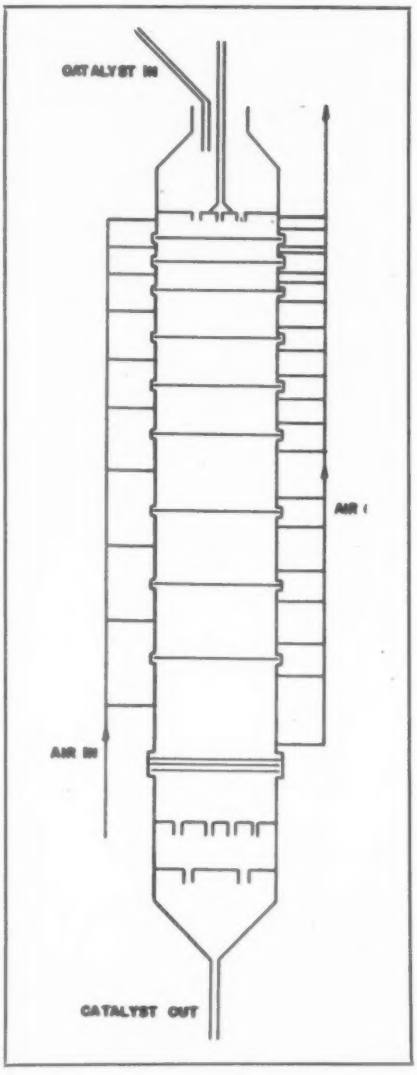

Fig. 10—Sketch of a recent TCC kiln for regenerating the spent catalyst. The catalyst flows downward, passing through alternate burning and cooling zones, the cooling zones being provided to keep the catalyst temperature below 1150° F., above which rapid deterioration of its activity takes place

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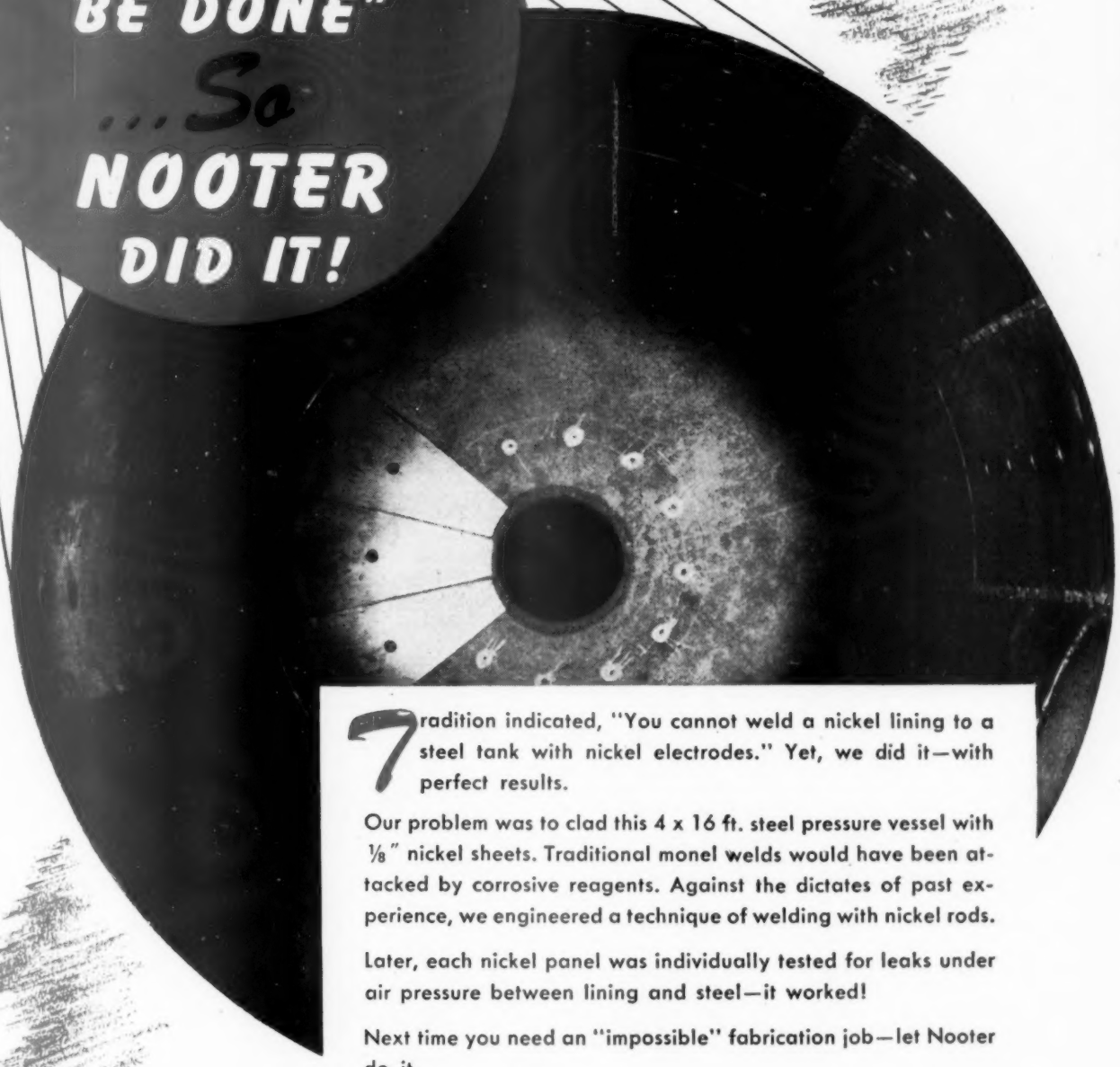

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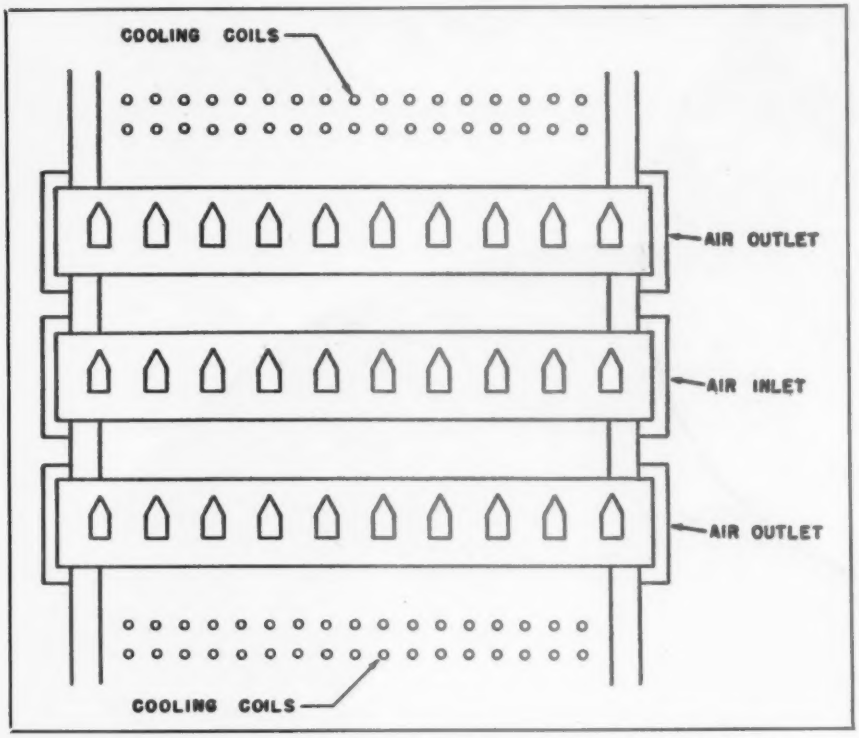

Fig. 11—Details of a typical burning and cooling zone in the TCC kiln

grid in the reactor, the distributor channels are narrow and deep.

At the exit of each burning zone is located a cooling coil or coils consisting of one or more banks of 2-in. coils on about 5-in. centers. The flow of water to these coils is arranged so that only those required to control temperature need be used. When a coil is cut off, the water is flushed out with steam to prevent excessive deposits of salt and scale.

The usual method of installing the cooling tubes provides for free expansion, but minimizes any leaks of air in or fumes out of the kiln. The tubes are supported by tube sheets at the end and by a tube support resting on a beam of heat resisting steel in the center. The tubes are rolled into the front tube sheet, and all outside connections of water and steam are made from this end. However, the tubes are not rolled into the rear tube sheet, but are free to expand. The return bends are in a box at the "rear" of the tubes, and this box is gas tight, so there is no gas leakage to the outside, in spite of the floating fit of the tubes through this tube sheet.

The air to the kiln is furnished by two vertical ducts, and the fumes are taken away by two other vertical ducts. The flow is controlled by dampers in the ducts. Since there are two separate air inlet systems, it is possible to use one for hot and one for cold air, so that any combination which is desirable for proper control can be obtained.

Since a certain amount of attrition of the catalyst is unavoidable, and also because some catalyst must be removed and replaced with fresh catalyst in order to maintain proper activity, provision is made to remove the catalyst fines by elutriation. The elutriator is incorporated in the upper part of the kiln where a small stream of regenerated catalyst is diverted from the reactor feed to the elutriator. Spent regeneration fumes pass upward counter-current to the catalyst. Using gas velocities in the order of 17 ft. per sec., it has been possible to eliminate substantially completely all material finer than about 14 mesh. See Fig. 12.

Elevators

The elevators are one of the important key units of the plant, and much study has been given to their mechanical design. The links are of low alloy steel and are designed to operate at temperatures up to 900° F.

The upper sprocket and head shaft are also designed for high temperature operation. The teeth of the sprockets are hard surfaced for satisfactory service with a minimum of lubrication. Experiments using a light volatile oil containing about 30% of fine graphite for lubrication of the sprocket teeth have shown that the oil is vaporized without residue, and the layer of graphite effectively lubricates the teeth and chain. The heat shaft is hollow and is water cooled. As a further precaution that the shaft is insulated between the sprockets, the main bearings are water cooled and lubricated by forced oil feed.

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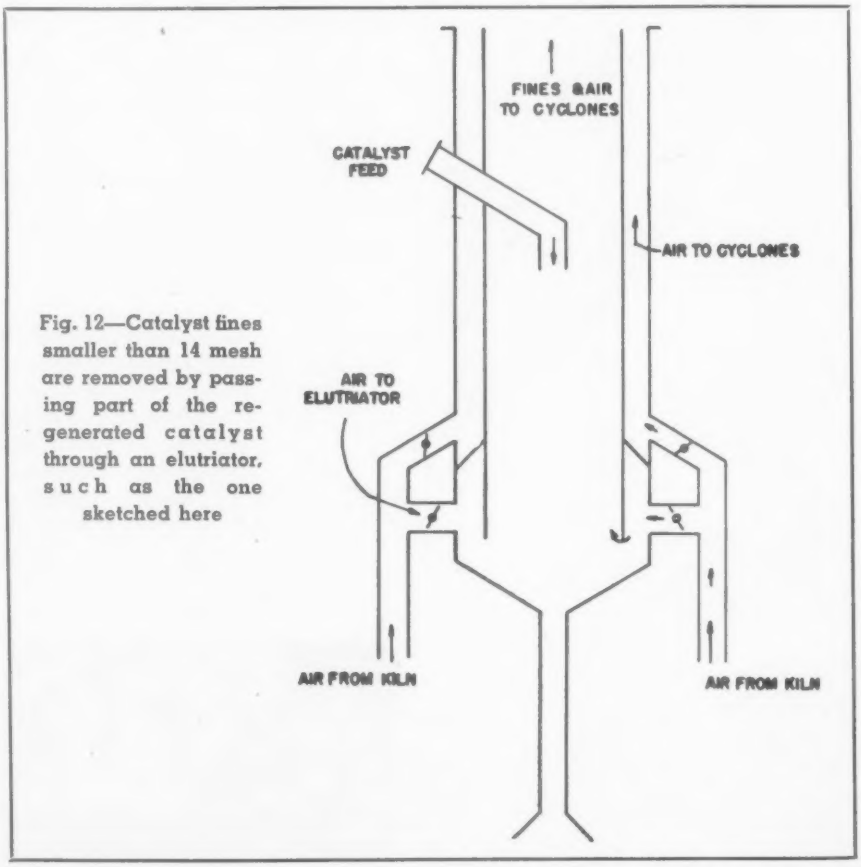

Fig. 12—Catalyst fines smaller than 14 mesh are removed by passing part of the regenerated catalyst through an elutriator, such as the one sketched here

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Keeping Up With the News

By N.P.N. Special Writer

This series is prepared in an attempt to correlate, in a technical-economic manner, certain of the current happenings in scientific and industrial circles which bear some relation to the future of the petroleum industry.

Petroleum technology, in its broadest sense, must include a study of the fields which relate to the use of petroleum products. Thus it occasions no surprise to find in this issue a discussion of postwar butadiene uses, followed by one on a new specific product, Styraloy, and then by a section on postwar private planes. Also discussed are ethyl chloride and methanol, both "chemicals from petroleum," and one phase of nonlaboratory chemistry.

The author of this series is a chemical engineer in the employ of the research subsidiary of one of the larger oil companies. His duties include a continuous survey of the current technical and economic journals in the many fields now related to the petroleum industry.

Postwar Butadiene Uses

A fairly recent private survey on the postwar uses of butadiene contains the following interesting summary(1):

"Butadiene, today an urgent necessity for the production of the Buna synthetic rubbers, may become a drug on the market should the use of synthetic rubbers cease or appreciably diminish after the war. Chemical industry prior to the war made little use of butadiene as a chemical intermediate, although a considerable amount of research on its reactions had been performed. Since butadiene will be available at a price of 10 cents or less per pound after the war, however, its economics will be considerably different.

"Reference to the literature indicates that butadiene can be used as an intermediate for the production of halogenated compounds, adipic acid and hexamethylene diamine (for nylon), hexamethylene glycol, maleic acid, tartaric acid, phthalic anhydride (and similar anhydrides), aromatics such as styrene, sulfones, Vitamin E intermediates, and numerous other compounds. Certain resins and plastics can also be synthesized from it. Still another use is the artificial ripening of fruit.

"In most cases, the economics of the methods set forth in the literature are not especially favorable as compared with those for existing commercial procedures. No large-scale markets were located by this survey, either, although several potential ones seemed to be indicated. It appears that an intensified program of research will be needed to find and to develop uses for butadiene if markets are to be assured in the postwar era."

This summary indicates rather clearly one problem the petroleum industry may face after the war. It is true that most of the butadiene plants are DPC-owned, hence would represent little capital loss to the industry if closed down for lack of markets. However, many privately financed refinery changes have been made to provide the necessary segregated feedstocks for these plants. The loss of a chemical market would relegate these stocks to the level of their fuel equivalents—useful chiefly for refinery heating—since it is doubtful if they would find much demand for use in the synthesis of alkylates and dimers.

If the demand for the butadiene-based synthetic rubbers does not continue at a relatively high level after the war, therefore, it would appear that the petroleum industry will face the loss of a potentially profitable market unless more diversified markets for butadiene are developed.

It is true, of course, that those of the petroleum industry's butadiene plants which are not of a temporary nature can produce butadiene cheaper than plants using nonpetroleum raw materials. It would therefore seem likely that, political developments aside, the petroleum plants would be the last to close in the wake of a shrinking market for the butadiene-based elastomers.

Styraloy

A recent plastics development, Styraloy, may prove of some importance in connection with the search for new uses for butadiene. This substance was first announced in 1943, while still in pilot plant scale production, but it was not until recently that it was disclosed that Styraloy is a copolymer of styrene and butadiene.

The order in which these monomers are listed and the name of the plastic tend to indicate that the major monomer is styrene (unlike the situation in Buna-S synthetic rubber, also a butadiene-styrene copolymer), but Styraloy and plastics like it might still provide a sizeable market for butadiene, although certainly not one comparable to the present demand for use in Buna-S. The Dow Chemical Co., however, has announced a new million-dollar plant to manufacture the material on a mass production basis.

Styraloy, in physical nature, is described as a cross between plastics, rubber, and wood; "so light that it floats on water, Styraloy has exceptional electrical properties, can be worked like wood, and as a molding powder lends itself to all common forms of plastic fabrication. According to Willard H. Dow, president of the company, it can be used to make everything from insulation in electric cables to water pipes that will not burst when frozen, unbreakable cigaret cases, shot gun shells, toys, and door knobs.

"It is manufactured in the form of a dark, blue-gray powder which forms products with varying degrees of hardness, from nearly as soft as rubber to very hard and tough. Its electrical properties definitely place it in the field of low-loss, low capacitance, high di-electric strength insulating materials.

"Among its other features are abrasion resistance better than shoe leather, low moisture absorption, and ability to remain flexible in a temperature range of −90°F. to well over 212°F."(2)

New plastics based on petroleum raw materials are announced frequently these days, but those based upon butadiene hold an interest all their own.

Postwar Private Planes

So much has been written on this subject, chiefly by enthusiasts who care little for economics, that the public has almost become educated to expect a "plane in every backyard"—one which can be flown after only a few hours of instruction, which will cost no more than an automobile, and which will contain all the aeronautical advancements discovered during the present war.

What to do about this situation has badly puzzled the makers of light

(1) Quoted by special permission of the company involved.

(2) Anon., *Chemical and Engineering News* 23, No. 7, 656 (1945), "Products and Processes—Styraloy."

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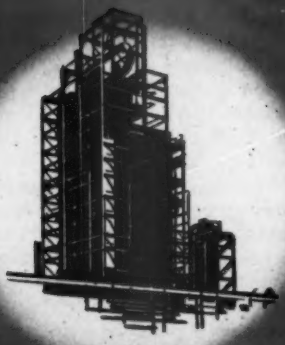

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planes. "The potential prospects for personal plane ownership has been surveyed again and again, and the results indicate that the public will demand a combination of comfort, safety, utility, and performance that would jack up the cost of an airplane to about ten times as much as a medium priced automobile.

"Thus the war-busy manufacturer faces the problem of finding a way to give his customer more than he has ever given him before despite greatly increased costs of both material and labor."(3)

The industry does believe, however, that it is "well within the realm of sound technological possibility that this research (on basic engineering, etc.) will make it possible to develop a four-or-five-seat plane designed around the engines now used in two-seaters and sold and operated at a cost no greater than that of present smaller planes."

The article quoted(3) points out that there may be a struggle in the small plane field between entering military manufacturers, with their large engineering staffs which "can wring the last drop of efficiency out of a given design," and "the little fellows," with their lower overhead costs. Consumer merchandising, also will be a new field for the military manufacturer, "whose chief customer has been the Army and Navy. The successful manufacturers will be those who put together the right combinations of basic engineering, productive efficiency, and effective merchandising."

There is evidently quite a difference of opinion as to the size of the postwar market and the speed with which demands will be met. "It is estimated that there were about 20,000 private plane owners before the war, that production was about 7000 a year. Because of its slow start on reconversion, the industry doubts that the postwar output will exceed this figure for some time. Aggressive merchandising, however, may boost potentials. As a result of its advertising begun half a year ago, Globe Aircraft reports 60,182 inquiries about its new two-seater, the "Swift." The article discussed then goes on to give a description of what the designers are planning in the way of personal planes.

In this connection, a few more details than usual were revealed in a recent Stinson advertisement(4). Planned "for future mass production," its Voyager-125 is described as "a family plane that carries the pilot and three passengers, with plenty of luggage space beneath the back seat. Powered by a 125-h.p. engine, it has a cruising range of 580 miles, a rate of climb of 670 feet per minute at sea level, and a service ceiling of 14,000 feet. It has a maximum speed of 128 m.p.h. and a cruising speed of 116 m.p.h. It takes off, with flaps down, after a run of 550 feet, lands with a roll of 280 feet." No price is mentioned, but a three-place plane of this make was marketed for $5,000 before the war(3).

The petroleum industry, of course, is primarily interested in finding out how all these factors will affect the peacetime fuel demands of private planes, in attempting to correlate popular desires with economic realities so that it may estimate the quantity of fuels desired and their quality (octane number).

Several attempts along these lines have already been made. G. K. Browder of American Airlines, Inc., recently told the S.A.E.(5) that civilian aircraft (including transports, presumably) will ultimately consume more than one billion gallons of gasoline per year (65,000 b/d). Dr. R. T. Goodwin of the Shell Oil Co., Inc., at the same meeting, "suggested that five grades (of gasoline) would be satisfactory for every type of plane: 80-octane for light and medium aircraft, 91 for regular use, 92 or 93 for special use in commercial planes engaged in main- or feeder-line operations, 100 for military use, and a possibly higher grade for long-range transoceanic flying."

The CAA believes that domestic aviation gasoline demand may amount to 43,900 b/d by 1949 and may expand to 74,700 b/d by 1954. Some 20,700 b/d of the 1949 demand would be from private (non-airline) planes, 7,200 b/d for pleasure flying, while the private plane demand in 1954 is estimated at 41,400 b/d: 14,400 b/d for pleasure flying, 5,600 b/d for "business," and 21,400 for "commercial" (non-airline) aviation.

To account for these demands, the Civil Aeronautics Administration expects the number of private planes to increase from the 22,650 certificated aircraft in 1942 to 200,000 planes in 1949 and 400,000 in 1954(6). Charles I. Stanton, deputy administrator of the CAA, recently stated that there will be 3,000,000 or more individuals at the end of the war who have been trained in some phase of aviation (ground forces included). According to Stanton, about 500,000 of these will be trained flyers, and others of this group will probably want to fly.

Many other pertinent estimates have been released in recent months. Paul Ryan pointed out last year that even 50,000 private pilots operating their planes 200 hours per year would use less than 5,000 b/d of aviation gasoline; furthermore, he does not believe that this figure will be reached(7). It is hard to correlate the CAA's figures with those of "conservatives," who believe that the postwar private plane market will approximate only 15,000-20,000 annually for the first few years after the war; it is true, however, that others believe that it will average 60,000 units per year for the first five years.

Only a few facts emerge clearly from this welter of figures. It would appear that small plane manufacturers are not even thinking of using 100-octane gasoline in the immediate postwar period. Secondly, it does not seem likely that private aviation will provide a real volume market for gasoline for some years to come. Finally, it would seem that the public ought to be better informed on its prospects of "getting something for nothing" if a truly sound private plane industry is to develop.

Ethyl Chloride

The recent announcement by the Ethyl Corp.(8) that it is producing ethyl chloride by a new process using "waste products" from another plant serves again to attract attention to one of the first chemicals ever to be produced from "petroleum" on a large scale.

What the new process involves is not quite clear, although it may be a substitutive reaction of chlorine with ethane itself, since this substance might be classed as a "waste product" insofar as ethylene is concerned when the latter is wanted.

Standard of Louisiana, at whose Baton Rouge refinery these plants are located, has in recent years built several plants which utilize the latter substance (ethylene), reacting it with hydrogen chloride. Normally, Standard is said to prepare this chemical by the catalytic reaction of hydrogen and chlorine, although, because of the chlorine shortage, it has had to rely heavily upon the presumably less-economic reaction of salt (sodium chloride) and sulfuric acid during the war.

Much use has also been made of an older process for the preparation of ethyl chloride—the hydrochlorination of ethyl alcohol, but increased alcohol demands coupled with the increase in demands for tetraethyl lead synthesis

(3) Anon., *Business Week*, No. 816, 21 (1945), "Fly Your Own?"

(4) *Automotive and Aviation Industries* 92, No. 8, 73 (1945).

(5) NATIONAL PETROLEUM NEWS 37, No. 15, 36 (1945), "Civilian Aviation 'Gas' Postwar Needs Put a Billion Gallons yearly."

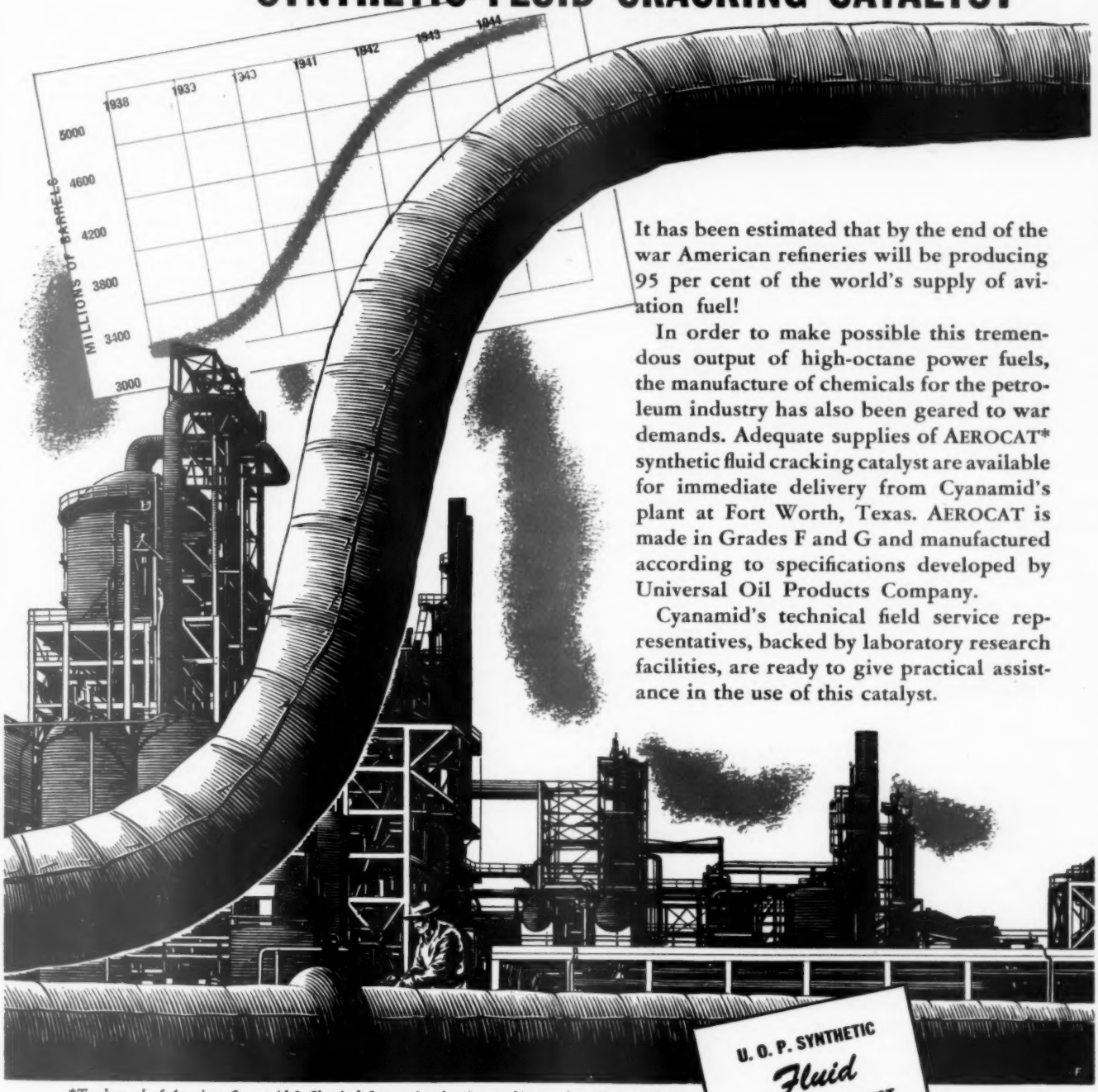
(6) Howard, N., NATIONAL PETROLEUM NEWS 36, No. 52, 27 (1944), "Plane Consumption to Top Billion Gallons Yearly by 1954, CAA Reports in Postwar Forecast."

(7) Ryan, P., NATIONAL PETROLEUM NEWS 36, No. 16, 42 (1944), "Leaders Tempering Postwar Optimism With Realism, Ryan Warns."

(8) Anon., NATIONAL PETROLEUM NEWS 37, No. 16, 36 (1945), "Ethyl Perfects New Process on Ethyl Chloride Using Waste Products from Baton Rouge Plant."

KEEP PRODUCTION CURVES UP WITH AEROCAT

SYNTHETIC FLUID CRACKING CATALYST



It has been estimated that by the end of the war American refineries will be producing 95 per cent of the world's supply of aviation fuel!

In order to make possible this tremendous output of high-octane power fuels, the manufacture of chemicals for the petroleum industry has also been geared to war demands. Adequate supplies of AEROCAT* synthetic fluid cracking catalyst are available for immediate delivery from Cyanamid's plant at Fort Worth, Texas. AEROCAT is made in Grades F and G and manufactured according to specifications developed by Universal Oil Products Company.

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(chief use of ethyl chloride) first called for the erection of another plant using ethylene, then (because ethylene supplies became inadequate to meet demand) the development of this new process.

Statistics on ethyl chloride are conspicuous by their scarcity. Production in 1938 was given as 65,000,000 pounds, and an estimate in 1941 placed capacity for that year as in excess of 200,000,000 pounds, but no further figures are available. Price structures are also not clear, but quantity lots probably sell for 10-15 cents per pound, except, perhaps, where alcohol is the raw material; here prices are probably somewhat higher.

For a time, prior to the synthetic rubber program, ethyl chloride was the highest tonnage "chemical from petroleum." At the same time it was the chemical produced in the greatest quantity from chlorine.

What awaits it in the future is not crystal clear, but there would seem to be little reason to expect a decline in demand for tetraethyl lead in the near future, and promising new markets may develop. Ethyl chloride is already being used in increasing quantities for the production of a fairly "new" plastic, ethyl cellulose, and also finds use as a local anesthetic, refrigerant, solvent, and "catalyst in synthetic rubber manufacture." Some of the processes now used for its manufacture are probably uneconomic, but that based on ethylene, at least, should see much postwar use.

Formaldehyde

Formaldehyde is a chemical which has increased tremendously in production in recent years, and along with this increase has come renewed attention to various methods of synthesis—many of them from natural gas or the "liquefied petroleum gases."

Production in 1933 totaled only 52,236,203 pounds; by 1940 annual production had risen to 180,884,573 pounds. With the advent of the war, however, demand increased by veritable leaps and bounds, so that 1943 production, for example, was an estimated 500,000,000 pounds[9], a tenfold increase over the 1933 figure.

Methanol is the raw material for by far the greater part of formaldehyde synthesis; it is "oxidized" to yield formaldehyde by passing it in the vapor phase, along with oxygen, over suitable catalysts. Actually, the process is usually one of reduction, accompanied by simultaneous oxidation of the hydrogen formed.

Increasing (but still "limited") quantities, however, are being produced by the oxidation of the lower hydrocarbon gases. Considerable publicity was given in 1943 to an announcement[10] of the commercialization of such a process by the Cities Service Oil Co., at Tallant, Okla., and other companies are reported to be using somewhat similar methods.

A very good summary of the published data on such processes may be found in a recent book on this subject[9]. The oxidation of methane, chief constituent of natural gas, has evidently received a vast amount of attention, but present commercial processes make use of C_2-C_4 gases, yielding a mixture of formaldehyde, methanol, acetaldehyde, and other oxygenated compounds.

If data taken from the patent literature may be considered as representative, "mixed catalyst comprising aluminum phosphate and metal oxides may be employed for the oxidation reaction, and pressures in the neighborhood of 7-20 atmospheres with temperatures of 430-480°C. are stated to be satisfactory. ° ° ° Typical liquid products were found to contain 34-36% methanol, 20-23% formaldehyde, and 5-6% acetaldehyde, together with varying amounts of higher alcohols, ketones, aldehydes, and water."[9] Patents containing the above data were assigned to Cities Service.

"The largest use of formaldehyde is in the manufacture of phenolic, cresylic, urea, casein, and melamine resins."[11] In 1943, for example, it is said that 260,900,000 pounds of formaldehyde were consumed in the production of 448,700,000 pounds of these resins. The first figure does not jibe with the aforementioned estimated 1943 production (500,000,000 pounds) of formaldehyde, however, since even in normal times over 70% of production went into the production of plastics, but, regardless of the accuracy of either estimate, it is easy to see that formaldehyde is vital to the production of resins which constitute well over half of present plastics production.

Other important uses are chemical synthesis (including that of certain explosives; use here might explain the above discrepancy) and use in the textile and paper industries, in tanning, in agriculture, and as a disinfectant and embalming agent.

It may well be expected that further attention will be paid to this substance, since its peacetime uses should be readily able to absorb wartime increases in production.

(9) Walker, J. F., *Formaldehyde*, Reinhold Publishing Corporation (New York), 1944.

(10) Anon., NATIONAL PETROLEUM NEWS, *Technical Section*, 35, No. 5, R-72 (1943), "Oil Company's Chemicals-From-Natural Gas Refinery Makes Formaldehyde, Methanol, and Related Compounds."

(11) Rager, C. A., *Formaldehyde, Synopsis of Information*, Bureau of Foreign and Domestic Commerce, Department of Commerce (Washington), 1944.

Nonlaboratory Chemistry

An increasing amount of attention is being given here, these days, to what our British friends call "library and intelligence service." In England, however, it would seem that "quite insufficient attention is paid to this important service, not only in the smaller companies. It should go farther than the provision of books, journals, regular information and abstract bulletins, and occasional translations.

"With efficient indexing, it would centralize the technical records of the firm—i.e., reports, technical data files, literature and patent surveys. It should be capable of supplying data in regard to raw materials, markets, foreign trade and chemical 'news.' It should be staffed with people trained in librarianship and technical subjects, capable therefore of following the trends of the company's work and hence stimulating the use of literature and past records by the chemist.

"The servicing of smaller firms by bulletins issued by trade, government and research associations requires extension; consideration should be given to the formation of joint library facilities for groups of small firms in the same area or the establishment for the same purpose of local intelligence centers. A general need in the industry is for more Russian translators and more comprehensive abstracting of the Soviet technical press."[12]

This subject was considered in some detail in a recent paper presented before the American Chemical Society[13]. This paper dealt with that type of service which is apart from library routine. The "important functions of such an information service are:

(1) summarization of the existing knowledge; (2) provision of information on current developments, gleaned from journals and the patent literature; and (3) preparation of patent surveys, which may analyze information not available elsewhere and may point to more efficient processes of importance to the war effort.

"Information gained from records of the past cannot always (or even often) replace actual research. The proper use of available information in this war emergency period, however, not only can save money for the companies involved, but also can conserve the time of workers vital to victory—workers who, even in peacetime, do not have the time, training, or inclination to carry out the detailed studies necessitated."

(12) Anon., *Petroleum* 8, No. 2, 33 (1945), "Nonlaboratory Chemistry."

(13) Weil, B. H. and Deitch, W. H., *Chemical and Engineering News* 22, No. 10, 808 (1944), "Information Service and the War Effort."

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Economic grade good creep strength properties. Somewhat more corrosion resistant than the chromium free steels.	*Exceptionally high creep strength* for polymerization and high pressure cracking. Otherwise similar in properties and characteristics to Croloy 2.	Somewhat better creep properties and better resistance to corrosion and oxidation than Croloy 2.
CROLOY 5	**CROLOY 7**	**CROLOY 9**
For operating conditions where corrosion resistance is primary requirement—provides good creep strength and oxidation resistance superior to Croloy 2.	Intermediate steel between Croloys 5 and 9 for operating conditions where corrosion resistance is the primary requirement. Somewhat more oxidation resistant than Croloy 5.	For severe operating conditions where high corrosion and oxidation resistance are essential—suitable for hydrogenation processes.
CROLOY 18-8S	**CROLOY 18-8SCB**	**CROLOY 25-20**
Practically unaffected by extremely corrosive oils at high temperatures. Has high creep strength and high resistance to oxidation.	Similar in properties to CROLOY 18-8S but stabilized with columbium, making it adaptable for welding or heating in carbide range.	For extreme resistance to oxidation and corrosion, for high-pressure, high-temperature services, as in hydrogenation, polymerization, and special heat-resisting installations.

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TA-1324

R-459

Tank Bottoms Seen as Source Of Microcrystalline Waxes

By Ernest Stossel

Tank bottoms from the storage of certain types of crudes are described as sources for the high melting point microcrystalline waxes which are coming into increasing industrial usage and may later become intermediate products for chemical manufacture. Need is seen for a simple process to be applied in the field to separate the wax from the oil, in order to avoid the high transportation costs of shipping wax and oil mixtures to wax refining plants. Such a process is said to be already in use on a commercial scale.

THE physical and chemical nature of many crude oils is such that they often deposit waxy material commonly called paraffin, congeal at normal winter temperatures, or are naturally so viscous that they present many difficult problems while being produced, transported, and stored.

These problems have long been recognized as aggravating and difficult to control or prevent. Mention of them can be found in discussions of production problems,(1) and articles have been published dealing with the problems of paraffin accumulation in Texas wells(2).

The most pronounced troubles from congealing oil and deposition of paraffin are encountered in oil fields that produce paraffin or mixed-base crude oils having a pour point of 20° F. or above. During the winter months it is often a serious problem to handle these oils in the flow lines and pipe lines. There are also year-round troubles occasioned by the deposition of paraffin in the wells.(1)

A thorough study made by the U.S. Bureau of Mines and published in a bulletin in 1932 deals mainly with the conditions under which these paraffin deposits accumulate and the problem of pumping and handling crude oils with high wax content.

Pipe line companies specify that crude oil purchased by them should not contain over a given percentage of "basic sediment". The amount of contamination allowed varies in different localities, but seldom exceeds a maximum of 2.0% B. S. & W. (basic sediment and water). By the term "B. S. & W." is meant the amount of emulsion and water contained in the crude oil.

Tank Bottoms Contain Wax

The crude meeting specification is purchased by the pipe line companies and pumped into large storage tanks, where it remains for varying periods, during which some of the basic sediment deposits in the bottoms of the tanks. In crudes having a paraffin content amorphous wax is interspersed with the basic sediment in the deposit, which often also contains particles of sand and scale. In course of time, as more and more crude passes through the storage tanks, the amount of deposit increases until it reaches proportions requiring cleaning of the tanks. These accumulated deposits are commonly called "tank bottoms".(3)

The waxes having the highest melting point and molecular weight present in the crude oil are the first to separate from solution, and can be found therefore in these tank bottoms. These waxes are of the same composition as the deposits in pipes of rods, pipe-wax and rod-wax which previously, in a report of the Bureau of Economic Geology, have been recognized as an "Ozokerite of exceptionally good quality."

Approaches European Ozokerite

The refined wax was reported to have a melting point of 79.5% C; spec. gr. 0.926; and refraction index 1.441. This approaches closely the specifications for good European Ozokerite, which owes its use and value to the fact that it combines the greatest chemical inactivity of paraffin with the physical properties of bees-wax. It was proposed to substitute these "waste waxes" for Ozokerite, which was almost exclusively imported from Europe before the supply was cut off at the outbreak of World War I.(4)

It seems that not much importance, however, was given to the wax content of crude oil deposits for nearly 20 years following. A great part of these wastes have been burned or otherwise disposed of, as cheap road oil and eventually as cracking stock. Less than 10 years ago the commercial possibilities of producing high-melting point waxes from crude oil emulsions, tank bottoms, and other crude oil deposits were recognized and process patents applied for.(5)

At that time these residues were also the object of intensive studies outside of the U.S. and a report was published by the Chemical Laboratory of the Geological Institute of Rumania in Bucharest, which also included certain commercially available petroleum waxes marketed under the name of "Hard Ceresine Sargo". This article is also interesting from an industrial point of view. By the usual method of determination of the Ceresine content by precipitation of the petroleum wax solution in chloroform with absolute alcohol, waxes have been separated having melting points as high as 198° F. These studies and tests of the laboratory led to the following conclusions:(6)

"These petroleum waxes separating naturally from paraffin-containing petroleums consist of hydrocarbons, the percentage of which varies between 77 and 96. The rest is composed of resins, asphalt-like substances and impurities. Of the hydrocarbons, 21-48% have a high melting point of 91-92° C; are difficultly soluble in benzine, ethyl ether and other organic solvents, and easily soluble in chloroform, but precipitable from this solution by absolute alcohol at 20° C. Besides these higher hydrocarbons the petroleum waxes contain a smaller quantity, between 6-13%, of solid hydrocarbons with a melting point of 57-60° C. This is the so-called soft ceresin. The residue consists of oily hydrocarbons.

"The hard ceresin obtained from petroleum waxes resembles in some respects the hard ceresins made from Ozokerite. This resemblance has been evident in the following qualities: appearance, specific gravity, insolubility in certain organic solvents, acting with fuming sulphuric acid and antimony pentachloride, 'absorption' of benzol and white spirit, micro-crystalline appearance and, finally, concerning the retention number.

Raw Material for Ceresins

"These qualities of resemblance to the hard ceresin obtained from Ozokerite show that the petroleum waxes can be considered an almost equivalent raw material for the production of ceresins."(6)

Similar results were also obtained from the materials in the U.S., as reported in the above mentioned bulletin of the Bureau of Mines. It also refers in detail to the results of fractionated precipitation of these waxes from solutions in acetone and/or ethylene dichloride and repeated re-crystallization. These processes are in principle the same which have been in use for the manufacture of high-melting waxes from still bottoms and residues of dewaxing of lubricating oils.

Most of the lubricating oil manufactured in the U.S. is made from crude oil that contains paraffin wax (so called "paraffin-base" or "intermediate base" crude). This wax has a boiling range similar to that of the lubricants found in the crude; consequently the lubricating distillates obtained from these crudes contain wax that must be removed before satisfactory lubricants can be produced.(7)

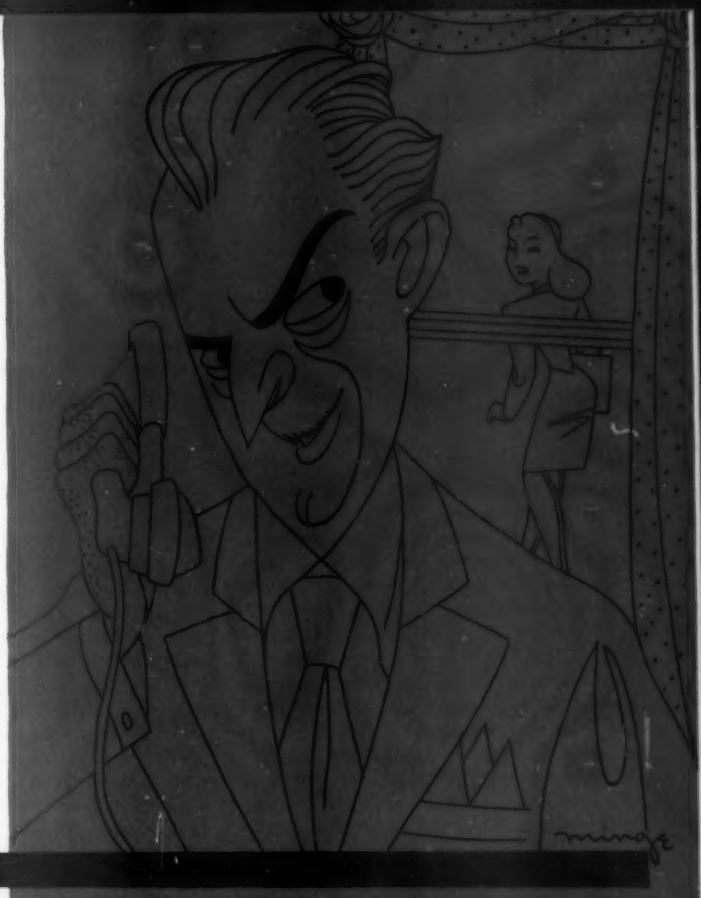
The waxes present in the distillates from petroleum are of a crystalline nature. Crystalline waxes from certain

Dr. Ernest Stossel is a graduate with a Ph D degree from the University of Vienna, where he specialized in research into the oxidation of hydrocarbons. He was formerly General Manager of the Warwick Wax Co., a subsidiary of Warwick Chemical Co., but resigned to start his own company.

F A M O U S

Caustic Comments

When invited to attend a dinner party given by a snobbish socialite, the late John Barrymore replied in caustic tones, "I'm frightfully sorry I won't be able to come, Mrs. Bore. I have a previous engagement which I shall make just as soon as I possibly can!"



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crude distillates having melting points as high as 185° F. have been prepared by extraction with dichlorethyl ether and by repeated re-crystallization.[8] Amorphous waxes having melting points of 185° F. have been prepared from petrolatum by solvent extraction and repeated re-crystallization. All these methods have in common the production of high-melting waxes by solvent separation processes and repeated recrystallization of the waxes in order to render them oil free.[9] [10]

Among the processes for the separation of high-melting bottom waxes distillation alone is unsuitable for the production of oil-free waxes, because after distillation the bottoms containing high-melting waxes still contain heavy oils which cannot be removed by distillation. Only a base stock can be produced from which high-melting waxes may be derived. Originally such a base stock was produced mainly as a by-product in the manufacture of lubricating oil.

The tank bottom waxes are not only an available source of high-melting point waxes. They will be in the future a basic material for a large series of modified waxes and other products for whose synthesis long chain hydrocarbons are essential; i.e., for higher fatty acids, alcohols and nitriles.

Tank bottom waxes of melting points up to 200° F. are now manufactured in car load quantities, but they are still mixtures of hydrocarbons probably from a chain length of about 40 carbons up; while paraffin is known to contain hydrocarbons of about 12 to 36 carbon atoms, mainly from about 12 to 24 carbon atoms.

Alcohols, Fatty Acids Obtainable

For certain reactions, as for instance in the oxidation of hydrocarbons whereby the chain length is mainly shortened and oxidation products with the same number of carbon atoms as the original hydrocarbons are not obtainable, it is therefore of great importance to start with hydrocarbons of higher molecular weight, as that of paraffin. Alcohols and fatty acids are thus obtainable with special waxlike qualities.

This is only to mention a few of the products which may be synthesized from hydrocarbons having a higher molecular weight than paraffin. Such hydrocarbons are also available as by-products from the synthesis of gasoline by the Fischer-Tropsch process and much work has been done, particularly in Germany, as to the possibilities of these high-molecular weight hydrocarbons for the synthesis of long chain compounds.

Tank bottoms, which among all the crude oil fractions contain the highest percentage of the valuable high-melting point waxes, have been considered as a raw material for these waxes only within the last 10 years or so. The base stock is usually produced by dehydrating and cleaning tank bottoms and reducing it to a residual bottom which contains the high-melting point waxes, asphaltic materials, and heavy oils.

After de-asphalting by solvent separation or sulphuric acid and bleaching with clay, the waxes are separated from heavy oils by dissolving in appropriate solvents at an elevated temperature and cooling the solution to effect precipitation of the wax, which eventually is filtered, washed to render it oil-free, and separated from the solvent by distillation. In principle the commonly used processes for solvent separation of wax and oil are also applied in the production of high-melting wax from tank bottoms.

In recent years large quantities of tank bottoms and crude oil deposits have been worked up for the production of high-melting point waxes. But as hap-

TABLE 1—Industrial Uses for Microcrystaline Waxes

Chemical Uses

- Rust preventives
- Rubber manufacture
- Chewing gum ingredient
- Egg preservative
- Fruit and vegetable coatings
- Cheese coatings
- Meat coating
- Poultry picking compound
- Honey combs
- Manufacture of synthetic wax
- Other dipping and spraying compounds
- Blasting supplies

Containers, Packaging and Wrapping

- Butter, Lard and Oleomargarine wrapping and packaging
- Other food packaging, cereal, dairy, cracker, etc.
- Bakery wraps
- Candy wraps
- Processed cheese wraps
- Dehydrated food wraps
- Soap wraps
- Tobacco wraps
- Other wraps except field rations
- Beer cans and kegs
- Milk containers
- Other liquid tight containers
- Pails, boxes and miscellaneous cartons
- Collapsible tubes

Containers, Packaging and Wrapping (continued)

- Caps and closures
- Kraft paper and bags
- Sealing compounds
- Machinery and parts packaging

Electrical and Communication Equipment

- Cable and wire insulation
- Coils and condensers
- Transformers
- Motors and generators—all types
- Batteries
- Lanterns and flashlights
- Transcription records (education, propaganda, amusement, central station, and reportorial)
- Radio parts
- Telephone and telegraph equipment—except cable and wire

Health, Safety and Scientific Uses

- Pill and tablet coatings
- Salves and ointments
- Other pharmaceutical supplies
- Dental Wax
- Cosmetics (creams, pencils, pomades)
- Paper cups
- Drinking straws

(Table 1 continued on page R-464)

Drill-Caliper-Tap-Plug-Weld?

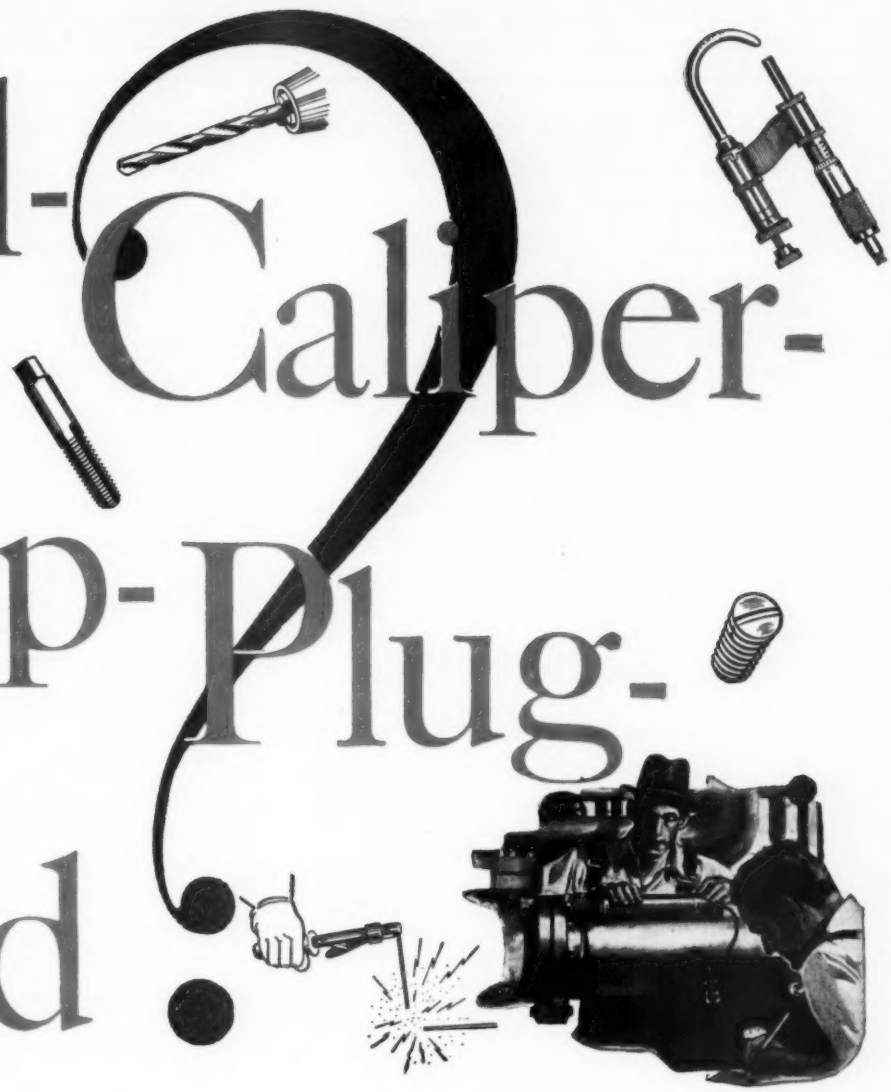

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TABLE 1 (continued)—Industrial Uses for Microcrystalline Waxes

Printing Ink, Printing, Publishing, and Engraving Accessories

- Photo engraving
- Engraving wax
- Electrotype—impression medium
- Printing inks (Gravure)
- Printing inks requiring adhesion to special surfaces, glass, metal, cellophane, rubber, plastics, etc.
- Printing inks requiring resistance to chemicals, oils, greases, foods, soaps, solvents, pasteurization, sterilization, weathering, heat, etc.

War Uses (Exclusively)

- Cartridges and shells
- Fire arms and guns
- Bombs
- Pyrotechnic ammunition (Flares, signal, photoflash)
- Ammunition and ordnance packaging
- Field ration packaging
- Paulins and engine covers
- Smoke poys and generators
- Secret military uses
- Airplane de-icing compound
- Ship launching grease

Textiles and Leather Treating (Basic Manufacture)

- Tentage—except paulins and engine covers
- Gas proofing—including headgear, gas masks, clothing, leggings and footwear, etc.
- Mildew proofing
- Raincoats and capes
- Other foul weather clothing—including headgear, leggings, footwear, etc.
- Waterproof textiles other than clothing (sheeting, shower curtains, adhesive tape, etc.)
- Shoe parts (Shoe adhesives, shoe fabrics, shoe uppers, house slipper uppers, platform binding, heel covers, shoe lining, sock lining, house slipper soling, shoe laces, etc.)
- Transmission belting
- Leather treatment, dressings, and polishes

Miscellaneous

- Candles and tapers
- Furniture and floor polishes
- Matches
- Crayons and colored pencils
- Carbon paper
- Water tanks and silos

pens so often when improvements in production decrease the price of a product and makes it available for new uses, the demand for high-melting point waxes exceeds by far the capacity of this relatively young industry. There has been a great demand by war industries, and wax has played and is playing a very important role in the war effort, as coating for metal parts, impregnation compounds for paper, wrapping of food, in the protection of army rations, in combination with plastics. A very detailed list was recently issued by the government. (See Table)

In some cases it was simply used as a substitute for scarce materials whose source of supply was cut by the war, but many new uses have been found where wax will hold the field even in peace times and the demand will probably expand when industries which are now able to obtain only research quantities of special waxes go into full production.

Although there are nearly unlimited amounts of high-melting wax potentially available from deposits of crude oil storage tanks the above described processes can make use of only a relatively small proportion of these tank bottoms because the bottoms containing the high-melting waxes separate mostly in the so-called producer tanks, before the crude oil is pumped to the refineries. These storage tanks are widely scattered, and even if the bottoms contain a relatively high percentage of wax (around 20% after dehydrating) the freight to the wax refining plant is in many cases prohibitive, as for one part of valuable wax 4 to 6 parts of crude oil must be shipped.

It is therefore of utmost importance for the future development of the market of high-melting point waxes, to separate the waxes from crude oil by simpler processes than those conventionally used.

Transportation Costs Important

All the known processes of separating wax from oil have been worked out with materials available as residuals in refineries, as wax distillates, long residuum, or petrolatum, and the question of transporting by rail did not arise. These conditions are different when residues from places far away from the refinery are worked up.

This idea was underlying the development of processes for which patents have been applied for recently by the writer of this article. This process, which separates high-melting wax from wax-bearing crude oils, tank bottoms, etc. without the use of solvents, is already in use for the production of high-melting waxes on a commercial scale, making use of the selective solvent properties of crude oil itself for the separation of the high-melting point waxes.

Until now this method has only been used for producing high-melting point waxes economically in the wax refining plant. It can, however, be applied for the separation of crude high-melting point waxes from heavy oil wherever these waxes deposit in quantity, in order to decrease the cost of transportation of stocks to the wax refining plant.

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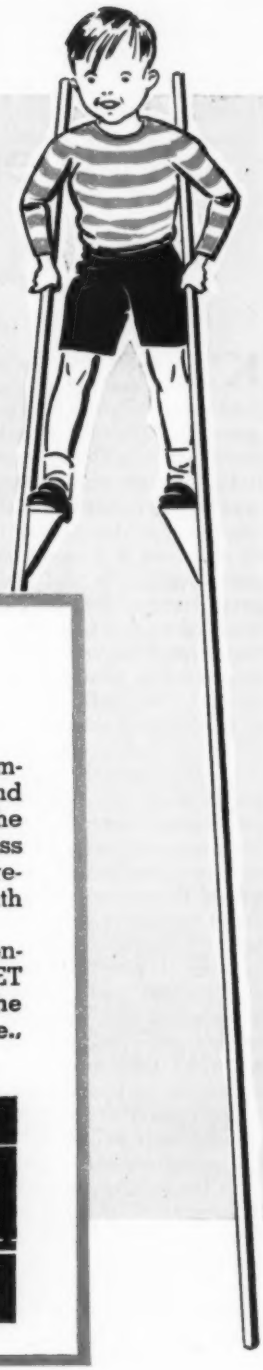

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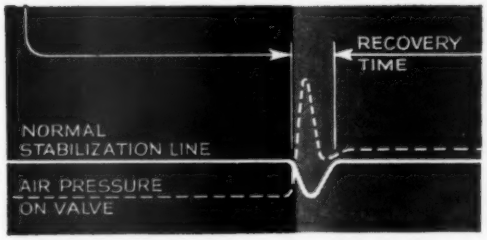

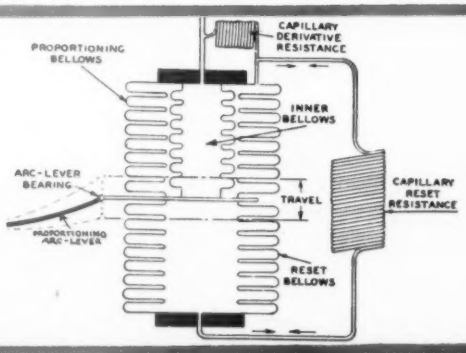

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Kinetics of the Process Of Thermal Polymerization of Butadiene

By S. V. Lebedev, M. A. Khokhlovkin, N. I. Kuibina and others

KINETICS of the thermal polymerization of unsaturated hydrocarbons attracts much attention. Thus, Pease investigated the kinetics of polymerization of acetylene[1] and ethylene[2].

In the first study, the polymerization was carried out at 400-650° C. and a conclusion was drawn that polymerization of acetylene is a bimolecular homogeneous reaction. It was seen as a bimolecular reaction because its velocity was retarded to one half when the acetylene was diluted with an equal volume of nitrogen. The homogeneous nature of the reaction was indicated by the decrease of the reaction velocity when the reaction tube was packed with broken glass.

In the second study, ethylene was polymerized at 350-500° and similar conclusions were drawn. However, the constants calculated by equations for reactions of the second order increase with rise of the amount of reacted substance. Pease explains it by a secondary reaction between ethylene and butene formed.

Thermal polymerization of butadiene at 325-390° and 1 atm. pressure was investigated by Vaughan[3], who also studied polymerization of isoprene[4] at 280-370°. Both reactions were treated as homogeneous bimolecular reactions. Also in this case the constants increased, beginning with the moment when 70% of the substance was converted.

At the research laboratory of the plant "Khimgaz"[5], thermal polymerization of butadiene was studied at 400-700° and the bimolecular reaction established. The growth of the velocity constants began at 50% conversion of the charge.

All of the above studies refer to substances in gaseous state at high temperatures, which is of significance for processes occurring in pyrolysis. The present study of thermal polymerization of butadiene was carried out in the liquid phase, i.e., it deals with processes occurring in polymerization in the real sense of this word. Since polymerization at temperatures below 100° is very inconvenient for determination of its velocity, the interval of from 110 to 200° was selected.

The kinetics of thermal polymerization in the liquid phase were first investigated by S. V. Lebedev[6] for the case of isoprene and 2,3-dimethyl-1, 3-butadiene. It was established in that study that:

(1) The relative amounts of dimers and polymers depend upon the temperature, and with rise of the latter the amount of the dimer increases and that of the polymer decreases.

(2) At constant temperatures, the relative amounts of dimers and polymers remain constant throughout the process and at 100-200° the process is not reversible in any direction.

E. N. Gapon[7] derived a mathematical expression of these regularities for polymerization of isoprene at 100-150°. He also concluded that thermal polymerization of isoprene is a bimolecular reaction and that the Arrhenius equation is applicable to the chemical conversion of a homogeneous liquid.

It is to be observed that polymerization of isoprene at 100° was investigated by Gapon up to 43% conversion; at 110°, up to 44%; at 130°, up to 76%; and at 150°, up to 79%. However, in all cases a continuous, although slight, increase of the constants was observed.

A different conclusion was drawn by Tammann[8] from polymerization of styrene, isoprene, dimethylbutadiene, etc. He regards the polymerization of these substances as a unimolecular reaction and thinks that before the molecules are joined they undergo changes which determine the velocity of the process. According to Staudinger[9], this change consists in liberation of double bonds in the molecules of the polymerized substances.

Experimental Part

Polymerization of butadiene was carried out in a closed oil thermostat of about 40 liters capacity. The temperature was maintained for one hour at the desired level with fluctuations of ±0.2°. It was made certain that during the experiment no light should penetrate into the thermostat and thus its effect on the velocity of the process was excluded. Sealed glass tubes of about 5 ml. capacity were used for the polymerization.

The butadiene used as starting material was prepared by regeneration from its tetrabromide melting at 117-118°. Since butadiene is sensitive to oxidation, all operations after regeneration and including charging butadiene into the tubes were carried out in the atmosphere of pure nitrogen checked by analysis. The regenerated butadiene was distilled from metallic sodium under a six-bulb still head with a jacket through which brine

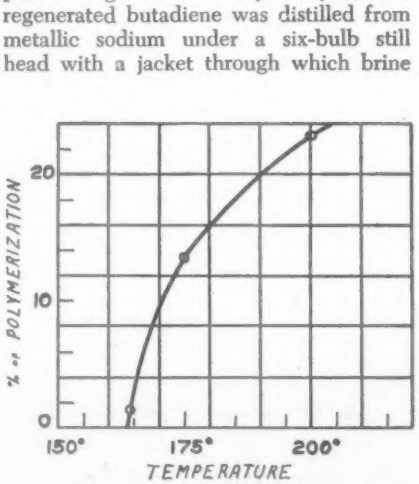

Fig. 1—Critical temperature of butadiene at various stages of polymerization

AUTHORS' CONCLUSIONS

1. Thermal polymerization of butadiene within the temperature interval of 110-200° was investigated, and reaction velocity curves obtained for each temperature.

2. Equations were derived giving the dependence of log K upon T^{-1} for reactions of the second order in the liquid and gaseous phases. From the slope of the lines, the energy of activation in the liquid phase was calculated to be about 13,000 calories and in the gaseous phase about 25,000 calories.

3. It was established that the order of the reaction changes with change of the temperature of the experiment. The average order of the reaction determined according to van't Hoff is approximately 1.5.

4. The reaction velocity constant calculated on the basis of the theory of collisions for reactions of the second order is sufficiently close to that experimentally determined.

5. The accelerating effect of oxygen on the process of thermal polymerization of butadiene was established; the effect of oxygen consists in increased formation of the polymer.

6. The homogeneous character of the reaction in the liquid phase was established.

This article is the fourth in a series of translations from Russian scientific literature, which is being published in the NPN Technical Section with the cooperation of the American Chemical Society's Petroleum Division.

The current article was completed after Lebedev's death in 1934, being written by Khokhlovkin and edited by Prof. I. I. Zhukov. It appeared originally in 1936 in "Zhurnal Fizicheskoi Khimii" (Journal of Physical Chemistry), vol. 6, p. 130, and later in "S. V. Lebedev, Life and Works," edited by A. E. Favorskii, A. P. Ostroumova-Lebedeva, V. Ya. Kurbatov and A. O. Yakubchik, 778 pgs., O.N.T.I., Khimteoret, Leningrad, 1938, pp. 647-662.

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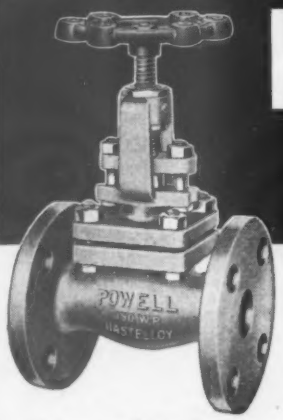

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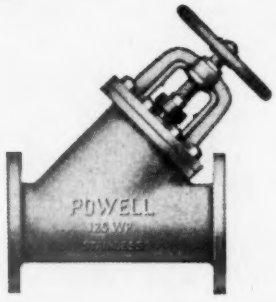

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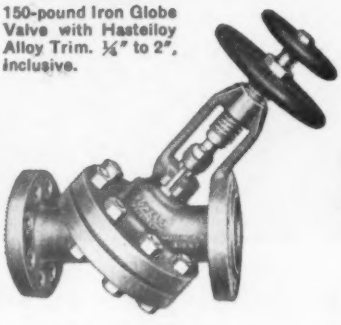

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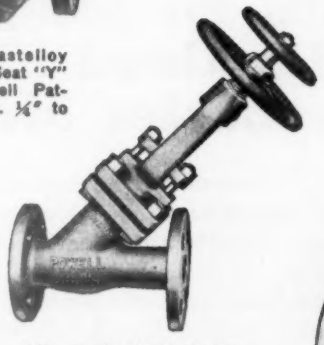

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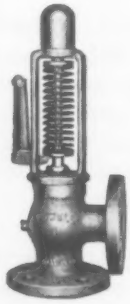

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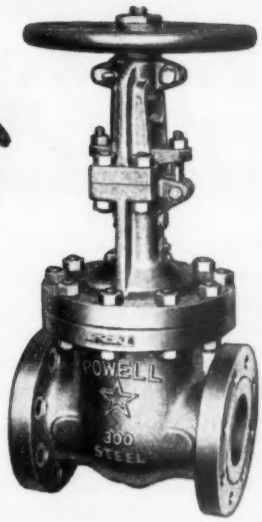

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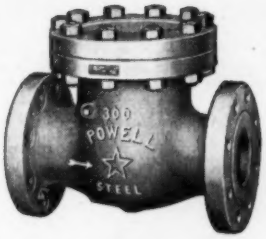

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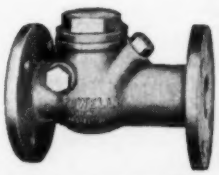

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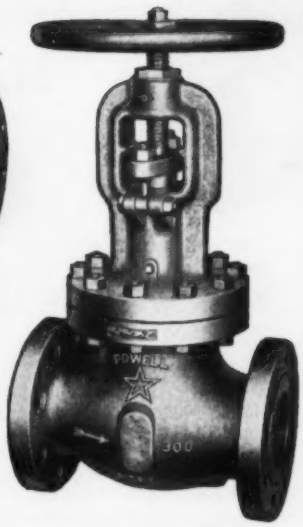

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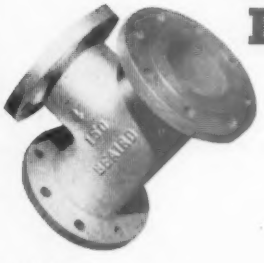

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TABLE 1

Temperature Coefficients at Various Temperature Intervals

Temperature Interval, °C.	Temperature Coefficient, γ
110-120	1.85
120-130	1.4
130-150	1.4
150-175	1.8
175-200	1.8

was circulated at a temperature of —7°. The middle portion of the distillate boiling at —4.3° was used for the experiment.

The butadiene from the still head was passed through a battery of wash bottles with alkaline pyrogallol and condensed in a receiver isolated from the air. The receiver was fitted with a syphon sealed at the outside end; this was opened after the distillation and butadiene charged under pressure of nitrogen into the ampules through which nitrogen was first blown. The tubes, containing from about 0.6 to 0.7 g. butadiene, were then sealed.

The products of polymerization were analyzed by distilling off the monomer from the tube by heating the latter to 125°. The upper part of the tube was cooled in this operation with the aid of a lead coil covering 7 cm. of the length of the tube (total length, 13 cm.) through which water kept at 0° was passed.

In several experiments, the amounts of the dimer and polymers were separately determined, for which purpose the monomer was first distilled off, followed by pumping off the dimer from the tube with the aid of an oil pump to constant weight within 0.001 g. At least two experiments were carried out at each point, and agreeing results were usually obtained.

To determine the effect of air, polymerization of butadiene that was in contact with air during the entire process of its preparation was investigated. This butadiene is termed in the following test "oxidized butadiene."

In view of the interruptions in the work, a new portion of butadiene had to be prepared each time the work was resumed. The results were compared by repeating the curve obtained at 120°. The newly prepared pure butadiene gave results agreeing with the preceding experiment (Table 2), which indicates the reproducibility of the experiments with pure butadiene.

In the polymerization experiments, temperatures of 110, 120, 130, 150, 175 and 200° were used. The work required determination of the critical temperature at several stages of polymerization. This was done as follows: The tube with butadiene was immersed into a glass thermostat kept at a definite temperature. At the moment of appearance of a meniscus, the ampule was taken out and rapidly cooled, followed by determination of the amount of polymerized substance. These results are shown in Fig. 1 in the form of an extrapolated curve giving the approximate critical temperature for butadiene as about 164°.

TABLE 2—Data from Experiments with the Polymerization of Pure Butadiene

Temp. of the Exp., °C.	Duration of heating, minutes	Amount of dimer + polymer	$K=\frac{1}{t}\cdot\frac{x}{a(a-x)}$	$K=\frac{1}{t}\ln\frac{a}{a-x}$	$K=\frac{2}{t}\left(\frac{1}{\sqrt{a-x}}-\frac{1}{\sqrt{a}}\right)$
110	2,880	0.37	0.204×10^{-3}	0.160×10^{-3}	0.180×10^{-3}
110	7,200	0.63	0.236×10^{-3}	0.138×10^{-3}	0.179×10^{-3}
110	10,080	0.75	0.297×10^{-3}	0.137×10^{-3}	0.196×10^{-3}
110	14,400	0.83	0.339×10^{-3}	0.123×10^{-3}	0.198×10^{-3}
110	18,750	0.88	0.291×10^{-3}	0.113×10^{-3}	0.201×10^{-3}
120	1,080	0.33	0.456×10^{-3}	0.371×10^{-3}	0.409×10^{-3}
120	1,440	0.38	0.425×10^{-3}	0.332×10^{-3}	0.375×10^{-3}
120	2,880	0.58	0.479×10^{-3}	0.301×10^{-3}	0.377×10^{-3}
120	4,320	0.72	0.595×10^{-3}	0.295×10^{-3}	0.412×10^{-3}
120	7,200	0.84	0.729×10^{-3}	0.255×10^{-3}	0.416×10^{-3}
120	10,080	0.89	0.803×10^{-3}	0.219×10^{-3}	0.400×10^{-3}
120	12,960	0.94	1.209×10^{-3}	0.217×10^{-3}	0.408×10^{-3}
120*	1,440	0.33	0.345×10^{-3}	0.278×10^{-3}	0.306×10^{-3}
120	4,320	0.70	0.550×10^{-3}	0.278×10^{-3}	0.382×10^{-3}
120	7,260	0.84	0.830×10^{-3}	0.252×10^{-3}	0.413×10^{-3}
120	10,207	0.92	1.174×10^{-3}	0.247×10^{-3}	0.496×10^{-3}
120	13,020	0.95	1.400×10^{-3}	0.230×10^{-3}	0.533×10^{-3}
130	240	0.13	0.622×10^{-3}	0.580×10^{-3}	0.600×10^{-3}
130	367	0.19	0.639×10^{-3}	0.574×10^{-3}	0.605×10^{-3}
130	720	0.31	0.621×10^{-3}	0.515×10^{-3}	0.564×10^{-3}
130	1,440	0.52	0.752×10^{-3}	0.510×10^{-3}	0.615×10^{-3}
130	2,880	0.74	1.988×10^{-3}	0.477×10^{-3}	0.667×10^{-3}
130	4,320	0.86	1.422×10^{-3}	0.455×10^{-3}	0.774×10^{-3}
130	5,760	0.91	1.755×10^{-3}	0.412×10^{-3}	0.809×10^{-3}
130	7,212	0.93	1.842×10^{-3}	0.368×10^{-3}	0.771×10^{-3}
150	30	0.04	1.209×10^{-3}	1.361×10^{-3}	1.400×10^{-3}
150	60	0.08	1.351×10^{-3}	1.389×10^{-3}	1.43×10^{-3}
150	120	0.15	1.424×10^{-3}	1.354×10^{-3}	1.42×10^{-3}
150	240	0.26	1.464×10^{-3}	1.255×10^{-3}	1.35×10^{-3}
150	840	0.73	3.219×10^{-3}	1.559×10^{-3}	2.20×10^{-3}
150	1,140	0.83	4.283×10^{-3}	1.554×10^{-3}	2.50×10^{-3}
150	1,440	0.88	5.093×10^{-3}	1.472×10^{-3}	3.31×10^{-3}
175	30	0.13	4.936×10^{-3}	4.566×10^{-3}	4.80×10^{-3}
175	60	0.24	5.292×10^{-3}	4.590×10^{-3}	4.90×10^{-3}
175	120	0.45	6.912×10^{-3}	4.963×10^{-3}	5.80×10^{-3}
175	184	0.58	7.664×10^{-3}	4.780×10^{-3}	5.90×10^{-3}
175	300	0.77	11.47×10^{-3}	4.973×10^{-3}	7.23×10^{-3}
175	420	0.88	13.07×10^{-3}	4.485×10^{-3}	9.01×10^{-3}
175	570	0.89	14.19×10^{-3}	3.873×10^{-3}	.....
200	7.5	0.14	21.70×10^{-3}	20.11×10^{-3}	20.8×10^{-3}
200	15	0.24	21.05×10^{-3}	18.30×10^{-3}	19.6×10^{-3}
200	30	0.40	22.22×10^{-3}	17.03×10^{-3}	19.4×10^{-3}
200	60	0.60	25.00×10^{-3}	15.27×10^{-3}	19.37×10^{-3}
200	90	0.76	35.19×10^{-3}	15.86×10^{-3}	23.13×10^{-3}
200	120	0.83	40.68×10^{-3}	14.77×10^{-3}	23.75×10^{-3}
200	160	0.87	41.82×10^{-3}	12.75×10^{-3}	22.16×10^{-3}
200	180	0.90	50.00×10^{-3}	12.79×10^{-3}	24.03×10^{-3}
200	210	0.92	54.76×10^{-3}	12.03×10^{-3}	24.14×10^{-3}
200	240	0.94	65.28×10^{-3}	11.72×10^{-3}	25.69×10^{-3}

* The experiments at 120° were repeated with a new portion of butadiene to determine the reproducibility of the experiments.

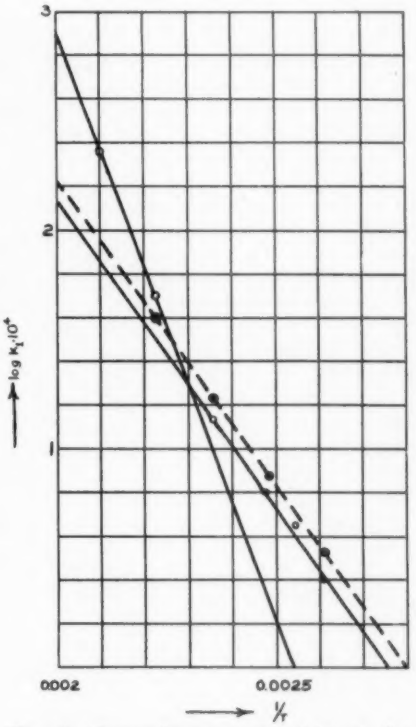

Fig. 2—Dependence upon 1/T of the logarithm of the initial velocity constants for the reaction of the second order

Discussion of the Results

The basic reaction in thermal polymerization at a given temperature consists in formation of the dimer of butadiene (ethenylcyclohexene)[10]. It could naturally be assumed that first a reaction of the second order occurs and the deviations from this reaction order can be explained by various causes.

From this point of view, and also in order to compare the data obtained by Lebedev with those of other authors, the dependence of the logarithms of the initial velocity constants for the reaction of

the second order upon $1/T$ was graphically determined (Fig. 2). Up to 150°, this dependence is expressed by a straight line, and above this temperature a break in the line occurs (in Fig. 2, the dotted line refers to oxidized butadiene).

Considering that the critical temperature for butadiene lies within the interval 150-175°, and, consequently, that the reaction proceeds at the beginning in the gaseous phase, this break is quite natural, especially because the values of the heat of activation calculated from the slopes of both sections of the line give for pure butadiene up to 150° the value of 12,870 calories and for the oxidized butadiene 13,000 calories (which, incidentally, contradicts the opinion of Storch, according to whom the effect of oxygen may reduce the energy of activation[11]). Above 150°, the value of 24,890 calories was obtained for pure butadiene. This agrees with data of Vaughan[4] and the data obtained at the "Khimgaz" laboratory[5] for gaseous butadiene.

The dependence of log K × 10^4 upon $1/T$ is in all cases expressed as follows:

at E = 12,870 calories,

$$\log K \times 10^4 = 2816/T + 7.771;$$

at E = 13,000 calories,

$$\log K \times 10^4 = 2488/T + 7.9;$$

at E = 24,890 calories,

$$\log K \times 10^4 = 5444/T + 13.829.$$

The temperature coefficient was calculated by the equation:

$$\log \gamma = \frac{10 \log (K_{t_2}/K_{t_1})}{t_2 - t_1}$$

and the values shown in Table 1 were obtained.

The assumption that the break in the line is caused by the critical temperature is also supported by the fact that the dependence of the logarithms of the constants upon $1/T$ is expressed at all temperatures by a straight line at a higher extent of conversion, corresponding to the reaction in the liquid phase. Fig. 3 shows the dependence of log $K \times 10^4$ upon $1/T$ corresponding to conversion of 83% butadiene.

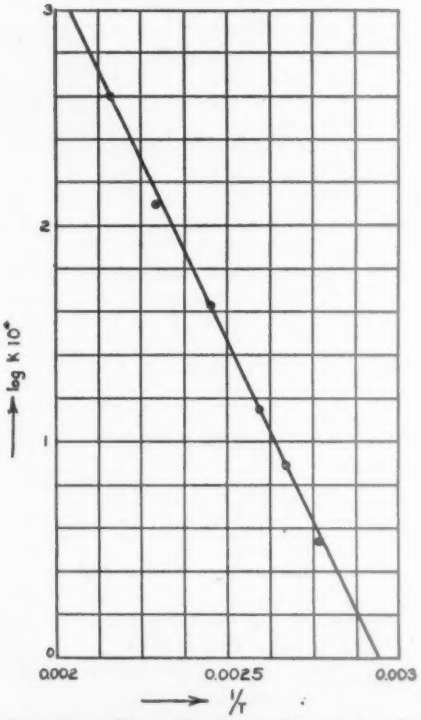

Fig. 3 — Dependence of log K × 10^4 upon 1/T corresponding to conversion of 83% butadiene

A growth of the constants of the second order reactions is revealed by the data of the Table 2. The course of this increase at all temperatures is peculiar. First, a slight decrease of the constant is observed, indicating a higher order than the second. Then the constant increases. Also, Vaughan[4] indicates this fact and explains the phenomenon by an incidental reaction possibly occurring and caused by traces of peroxides in gaseous isoprene.

Further, the tables show that the rise of the constants of the second order reactions becomes more pronounced with the increase of the reaction temperature. It follows from this that if the growth of the constants is due to the catalytic action of the reaction products, the part of the catalyst may be played by the dimer, for at low temperatures, when the extent of formation of the polymer is considerably higher, the rise of the constants is substantially smaller than at high temperatures.

The order of the reaction was determined from the van't Hoff equation:

$$n = \frac{\log dC_1/dt - \log dC_2/dt}{\log C_1 - \log C_2}$$

and the value of approximately 1.5 was obtained. The values obtained for different temperatures are shown in Table 3.

TABLE 3—Order of the Reaction, Determined by the van't Hoff Equation

Temp., °C.	Order of the Reaction
Pure Butadiene	
200	1.47
200	1.51
150	1.47
130	1.49
Oxidized Butadiene	
150	1.21
130	1.27

The constants calculated by the equation

$$K = \frac{2}{t}\left(\frac{1}{\sqrt{a-x}} - \frac{1}{\sqrt{a}}\right)$$

for the order of 1.5 and second order of the reaction for pure and oxidized butadiene are reported in Table 4. At 110, 120 and 130° the velocity constant preserves its value in reactions of the order of 1.5. At 150 and 175° the order of the reaction seems to be reduced and the constant preserves its value for reactions of the first order. Finally, at 200°, the reaction assumes again the order of 1.5. Within the limits of each temperature the constant begins to increase at approximately 50% conversion of the charge.

It could be assumed that the processes of dimerization and polymerization involve reactions of different orders. In this case, dimerization should be regarded as a unimolecular reaction and polymerization as a bimolecular reaction. This follows from the fact that with rise of the temperature, the relative amount of dimer (see below) increases and the reaction

TABLE 4—Data from Experiments with the Polymerization of Oxidized Butadiene

Temp. of the Exp., °C.	Duration of heating, minutes	Amount of dimer + polymer	$K = \frac{1}{t} \cdot \frac{x}{a(a-x)}$	$K = \frac{1}{t} \ln \frac{a}{a-x}$	$K = \frac{2}{t}\left(\frac{1}{\sqrt{a-x}} - \frac{1}{\sqrt{a}}\right)$
110	1,140	0.34	0.360 × 10^{-3}	0.289 × 10^{-3}	0.320 × 10^{-3}
110	2,880	0.49	0.333 × 10^{-3}	0.234 × 10^{-3}	0.277 × 10^{-3}
110	5,760	0.65	0.322 × 10^{-3}	0.182 × 10^{-3}	0.329 × 10^{-3}
110	8,880	0.83	0.549 × 10^{-3}	0.199 × 10^{-3}	0.321 × 10^{-3}
110	11,520	0.87	0.581 × 10^{-3}	0.177 × 10^{-3}	0.301 × 10^{-3}
110	12,960	0.89	0.599 × 10^{-3}	0.170 × 10^{-3}	0.310 × 10^{-3}
110	13,680	0.91	0.739 × 10^{-3}	0.176 × 10^{-3}	0.340 × 10^{-3}
130	240	0.15	0.735 × 10^{-3}	0.677 × 10^{-3}	0.709 × 10^{-3}
130	361	0.19	0.649 × 10^{-3}	0.769 × 10^{-3}	0.615 × 10^{-3}
130	720	0.41	0.955 × 10^{-3}	0.733 × 10^{-3}	0.839 × 10^{-3}
130	1,440	0.61	1.080 × 10^{-3}	0.654 × 10^{-3}	0.834 × 10^{-3}
130	2,880	0.81	1.480 × 10^{-3}	0.577 × 10^{-3}	0.898 × 10^{-3}
130	4,320	0.89	1.873 × 10^{-3}	0.510 × 10^{-3}	0.932 × 10^{-3}
130	7,200	0.98	2.639 × 10^{-3}	0.416 × 10^{-3}	0.686 × 10^{-3}
150	30	0.05	1.791 × 10^{-3}	1.710 × 10^{-3}	1.733 × 10^{-3}
150	120	0.16	1.634 × 10^{-3}	1.453 × 10^{-3}	1.512 × 10^{-3}
150	240	0.29	1.743 × 10^{-3}	1.425 × 10^{-3}	1.558 × 10^{-3}
150	480	0.52	2.256 × 10^{-3}	1.529 × 10^{-3}	1.345 × 10^{-3}
150	660	0.65	2.813 × 10^{-3}	1.590 × 10^{-3}	2.091 × 10^{-3}
150	745	0.71	3.286 × 10^{-3}	1.624 × 10^{-3}	2.30 × 10^{-3}
150	840	0.76	3.764 × 10^{-3}	1.699 × 10^{-3}	2.478 × 10^{-3}
150	1,500	0.86	4.095 × 10^{-3}	1.311 × 10^{-3}	2.229 × 10^{-3}
175	15	0.08	4.225 × 10^{-3}	4.122 × 10^{-3}	4.133 × 10^{-3}
175	30	0.10	3.869 × 10^{-3}	3.512 × 10^{-3}	3.60 × 10^{-3}
175	60	0.20	4.557 × 10^{-3}	3.72 × 10^{-3}	3.933 × 10^{-3}
175	120	0.37	4.980 × 10^{-3}	3.851 × 10^{-3}	4.333 × 10^{-3}
175	173	0.51	6.113 × 10^{-3}	4.124 × 10^{-3}	4.953 × 10^{-3}
175	300	0.71	8.121 × 10^{-3}	4.032 × 10^{-3}	5.713 × 10^{-3}
175	420	0.80	9.829 × 10^{-3}	3.832 × 10^{-3}	6.128 × 10^{-3}
175	570	0.88	12.62 × 10^{-3}	3.720 × 10^{-3}	6.621 × 10^{-3}

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TABLE 5

Temp. of the Exp.	Minutes	lg W	lg C	Order of the reaction	Reaction velocity constant
110°	1,440	3.989	1.875	1.14	0.708×10^{-4}
110°	7,200	3.552	1.568		
110°	18,750	3.098	1.079		
120°	1,080	2.447	1.826	1.2	1.05×10^{-4}
120°	2,880	3.982	1.623		
120°	7,200	3.480	1.204		
120°	12,960	4.885	0.699		
175°	300	2.845	1.352	1.4	9.12×10^{-4}
175°	570	2.426	1.041		
200°	7.5	0.211	1.935	1.4	2.82×10^{-3}
200°	60	1.754	1.602		
200°	120	1.236	1.230		
200°	180	2.869	1.000		

TABLE 6

Temperature of the experiment	K_1 calculated	K_2 experimentally determined	K_2/K_1
200°	5.66	9.33	1.6
175°	1.97	1.94	0.99
130°	0.052	0.262	5.04*
130°	0.052	0.263	5.06
120°	0.033	0.124	3.76

* For 130 and 120°, this calculation is not entirely suitable, since in this case a considerable amount of liquid is present.

TABLE 7—Data on the Amounts of Dimer and of Polymer Formed in Experiments with Pure Butadiene

Temp. of the Exp., °C.	Polymer fraction	Dimer fraction	Ratio of the dimer to the polymer	Heating period, minutes
110	0.04	0.21	5.3	1,440
110	0.08	0.55	6.9	7,200
110	0.12	0.76	6.3	18,750
120	0.02	0.31	16	1,080
120	0.03	0.55	18	2,880
120	0.04	0.80	20	7,200
120	0.05	0.84	17	10,080
120	0.06	0.89	15	12,960
130	0.05	0.81	16	4,320
175	0.031	0.744	24	300
175	0.036	0.854	23.7	570
200	0.006	0.134	22	7.5
200	0.023	0.577	25	60
200	0.030	0.73	24	90
200	0.039	0.791	20.3	120
200	0.047	0.853	18.2	180

TABLE 8—Data on the Amounts of Dimer and of Polymer Formed in Experiments with Oxidized Butadiene

Temp. of the Exp., °C.	Polymer fraction	Dimer fraction	Ratio of the dimer to the polymer	Heating period, minutes
110	0.18	0.16	0.9	1,440
110	0.20	0.45	2.3	5,760
110	0.20	0.71	3.5	13,680
130	0.11	0.78	7.1	4,320
130	0.11	0.87	7.9	7,200
150	0.06	0.46	7.7	480
150	0.08	0.78	9.8	1,500

TABLE 9—Effect of Glass Packing on Reaction Velocity

Temp. of Exp., °C.	Reaction Time, hr.	Amt. of Glass, g.	Grain Size, cm.	Polymer—Dimer, %
150	5	0.6093		30
150	5	4.2260		39
150	5	4.6904	>0.75	33
150	5	control		28
150	5	control		33
130	13	2.5044		36
130	13	2.3548	>0.75	27.3
130	13	control		30.2

order approaches 1. The first order of the reaction of dimerization may be determined by the fact that the velocity of the reaction itself exceeds the velocity of the process of activation occurring in the molecule.

This explanation would unavoidably require that the nature of the process of activation of the molecules forming the dimer and those forming the polymer should be different. The velocities of oxidation should also differ; otherwise, the second order of the reaction of polymerization could not be explained.

The above assumption is not well based, and is contradicted by the constancy of the ratio of the dimer to the polymer at any definite temperature. However, the graphical calculation of the order of the reaction of formation of the dimer at certain temperatures gives a value of about one.

Graphical differentiation of the curves for the formation of the dimer based on the data of Table 7 was used for determining the order of this reaction. It was found that the order of the reaction determined from the slope of the line expressing the dependence of the logarithms of the reaction velocities ($\log W$) upon the logarithms of the concentration ($\log C$) approached about one for the temperatures 110 and 120°. At 175 and 200°, values averaging at 1.4 were obtained.

The obtained data are shown in Table 5. The values of the constants were arrived at by extrapolation of the velocities line to the ordinate corresponding to the value of the concentration of butadiene equal to one.

It is also noteworthy that the reaction occurs under changing pressure; for instance, at 200° the pressure drops from about 80 atm. (if the possible association of butadiene molecules is left out of account) to the insignificant value of the vapor pressure of the dimer. The effect of the pressure on the velocity of thermal polymerization was investigated by Tammann[8], who established the following ratio of the velocity constants characterizing the change of the reaction with rise of the pressure from 1 to 1500 atm. at the same temperature:

$$\frac{K_{1500}}{K_1} = 5.90 \times 10^6$$

and from 500 to 3000 atm.,

$$\frac{K_{3000}}{K_1} = 25.0$$

According to Connant and Tonberg[12], a 15° change of the temperature in polymerization of isoprene under high pressure is equivalent to 3000 atm. pressure. A change of pressure from 2000 to 12,000 atm. raises the velocity approximately 100 times. It follows that with reduction of the pressure within the limits of the same temperature, the constants should decrease and not increase.

A similar regularity was established by Pease[1]. He showed that polymerization of ethylene is a reaction of the second order under high pressure and approaches the third order under low pressure.

Considering the above, the increase of the constants of the second order reaction observed by the author cannot be explained by the effect of the pressure.

Since conditions prevailing in these experiments substantially differed from those employed by the above mentioned

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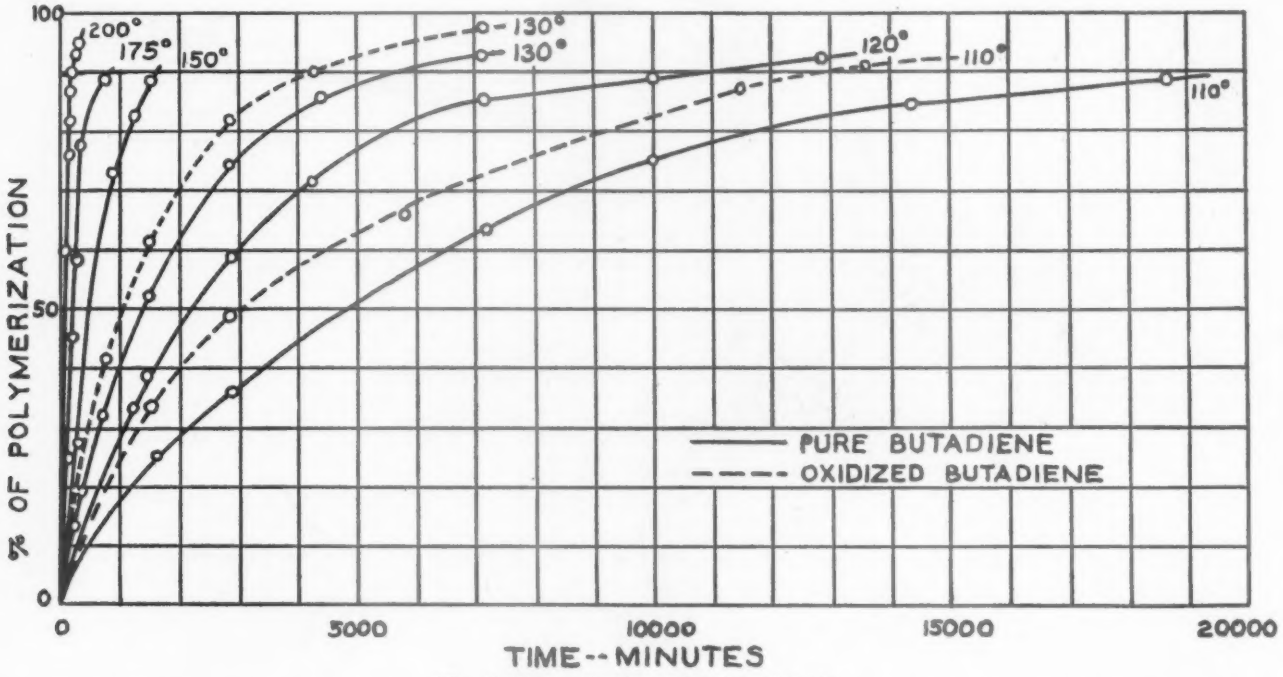

Fig. 4—Rate of polymerization of butadiene at various temperatures. Note that butadiene subjected to the action of air (oxidized) polymerizes at a faster rate than the pure material

authors, calculation of the velocity constants on the basis of the theory of collisions is of interest. It is to be borne in mind that at temperatures above the critical, butadiene is present in the beginning of the reaction in the gaseous state. For high temperatures, Vaughan[4] obtained a ratio of the calculated constant to that experimentally determined for butadiene amounting to 1/16,800; a totally different result was obtained by the present author.

To compare the data obtained by the author with those obtained by Vaughan[3], the calculation was carried out considering the process as a reaction of the second order. The following formula was used:

$$Z = \sqrt{r}\pi r^2 u n^2 \sqrt{T}\, e^{-E/RT}$$

in which r is the diameter of the molecule of butadiene amounting to 4.5×10^{-8}, u is the square root of the square of the average velocity of the molecules, and n is the number of molecules per 1 ml. The results of the calculation are shown in Table 6. The constants are expressed in g.-mol. per minute. The experimental constants were calculated for the initial moments of the reaction. An agreement of the calculated constants with the experimental values is seen to have been obtained.

If it is considered that in the process of polymerization an unstable intermediate complex is formed from two molecules of butadiene, the pressure evidently promotes its stability.

Data are shown in Tables 7 and 8 obtained in experiments in which the amounts of the dimer and the polymer were determined. The basic assumptions of S. V. Lebedev are seen to be supported by the data for pure butadiene. The ratio of the dimer to the polymer remains constant for the given temperature. This ratio changes with rise of the temperature toward increasing the relative amount of the dimer.

The constancy of the ratio of the dimer to the polymer indicates that the formation of the two products involves a reaction of the same order. The constancy of the ratio of the dimer to the polymer is also pointed out by Gapon[7] and by Whitby and Crozier[13].

Butadiene subjected to the action of air is shown by the results of this study to polymerize at a considerably higher rate than pure butadiene (Fig. 4).

Fig. 5

Fig. 6

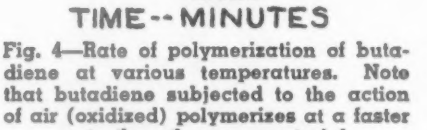

Fig. 7

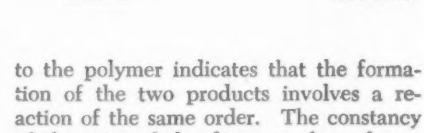

Fig. 8

Figs. 5-8—Effect of oxygen on the polymerization of butadiene. The amount of dimer (Figs. 5 and 7) is greater with pure butadiene than with oxidized butadiene, while just the opposite is true in the case of the amount of polymer that is formed (Figs. 6 and 8), indicating that oxygen exerts a preferential effect on the formation of the polymer

Similar conclusions were arrived at by Connant[14], Lehner[15], Storch[11] and other investigators of the effect of oxygen upon polymerization of unsaturated compounds. It is to be remarked that oxygen can in no case be regarded as an inert gas with respect to butadiene, as assumed by Rubanovskii[16].

Obviously, oxygen exerts a preferential effect on the formation of the polymer. This is illustrated in Figs. 5-8, from which it also follows that the effect of oxygen is exerted chiefly at the beginning of the process. Because of this action of oxygen, the constancy of the ratio of the dimer to the polymer is distorted.

The effect of glass packing of the tube upon the reaction velocity was investigated and the results are shown in Table 9. In the liquid phase the reaction is shown by these results to be homogeneous, because its velocity does not depend upon the glass packing, which greatly increases the surface.

This fact, as well as other observations, such as the reproducibility of the experiment, absence of induction period and complete cessation of the process on cooling, seem to indicate that no chain mechanism of the process is involved under these conditions. Evidently, this should refer to both reactions occurring in thermal polymerization, because at low temperatures, at which considerable quantities of the polymer are formed, no induction period is observed.

The only fact pointing to a possible chain mechanism of the process is the growth of the constants; however, it follows from the discussion given above that this may also be explained in a different way.

In conclusion, it is pointed out that selection of a suitable temperature interval made it possible to establish the difference between the homogeneous reactions in the liquid and gaseous phases. The obtained data may be used as material for solution of problems connected with research on the liquid state.

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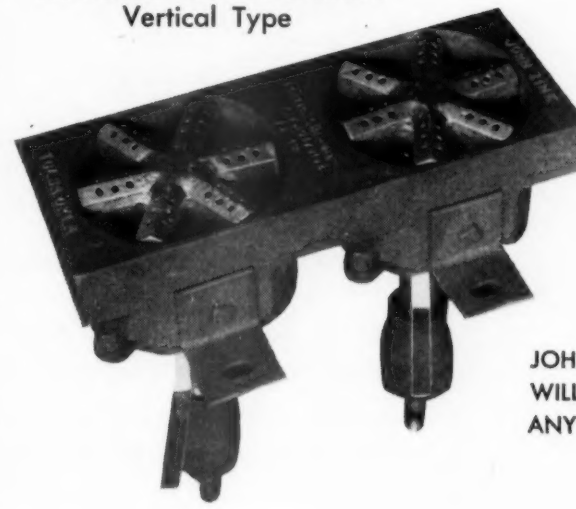

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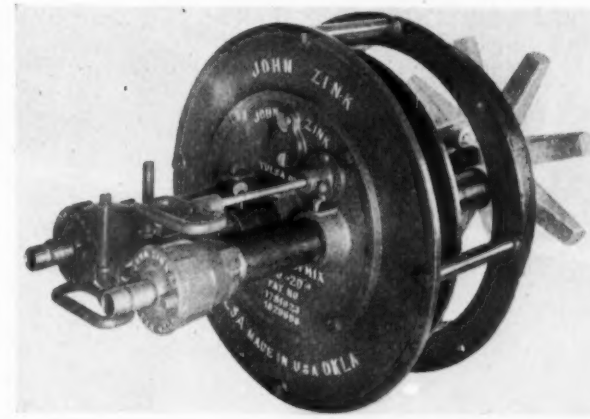

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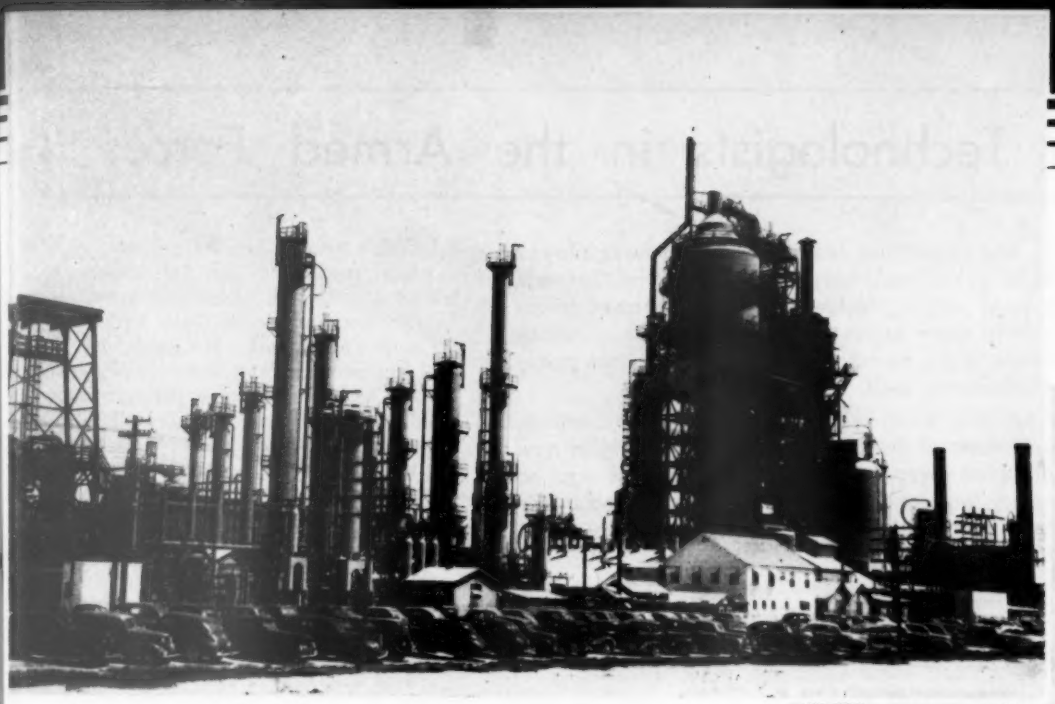

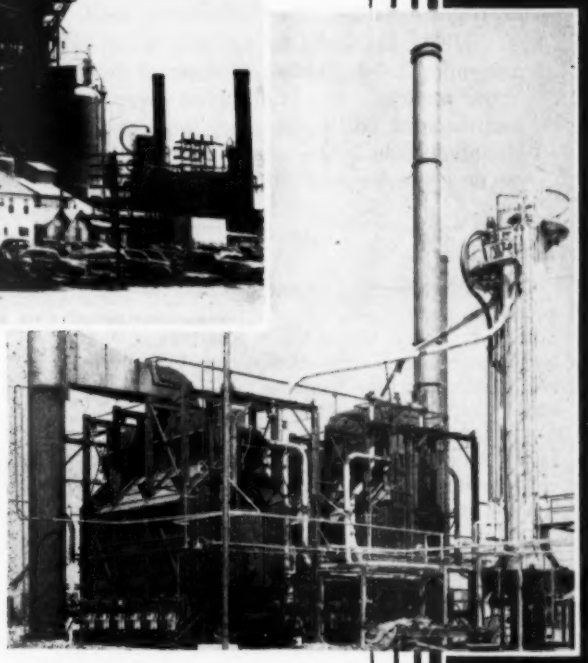

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NPN's Technical Section this month concludes a series of two articles presenting brief sketches of some of these oil company technologists now in the services. The information given was secured some months ago, so that the rank and activities of some of the men may have changed in the meantime. In many cases their work is of a confidential nature and nothing can be said about it.

Ethyl Corp.

Lt. (j.g.) Merrill J. Anderson is engaged in engine research on fuels and lubricants at the U. S. Naval Engineering Experiment Station, Annapolis, Md. He enrolled in the training school of Ethyl Corp. in 1939 with a B.S. degree from University of Illinois and an A.B. from Augustana College, joining the Engineering Research Dept. a year later, leaving in 1942 to enlist in the Navy.

Ensign Christopher E. Bruhl also is with the Naval Engineering Experiment Station at Annapolis. A native of New York, he came to Ethyl Corp. in 1941 and was a gasoline technician at Yonkers testing laboratory when he entered the Navy in 1943. He graduated in chemical engineering from New York University.

Ensign Bruhl

Ensign Carlson

Ensign Walton L. Carlson is another with the U. S. Naval Experiment Station at Annapolis, engaged in engine research on fuels and lubricants. He entered the employ of Ethyl in 1940, completed the engineering training course required of all new men, was briefly assigned to the gasoline testing laboratories and was research engineer and technical photographer when he enlisted in the Navy in 1942. Ens. Carlson has a B.S. in mechanical engineering from University of Illinois.

Lt. Jess J. Carmichael is with Headquarters, Pipeline Dept., A.B.S., and was recently attached to the Fifth Army in Italy as a staff member of an engineering petroleum distribution unit. He was formerly gasoline technician at the North Kansas City testing laboratory and had been with Ethyl seven years. He is a graduate of University of Michigan and had a varied experience as utilities engineer and inspector for the War Department before joining Ethyl.

Lt. Carmichael

Major Dees

Major H. C. Dees, a member of the Petroleum Division of the Army Air Forces at Washington, is concerned with the quality of gasoline purchased for the Air Forces. After an association with the Standard Oil Co. of Louisiana he joined Ethyl in 1931 as field representative, Chicago Division, serving subsequently as assistant manager there and at the Tulsa Division, and later as manager of the Baltimore Division before joining the Army in 1942. He is a graduate of University of Kentucky.

Lt. Col. William H. Hubner is with the A.S.C. Headquarters, Fifth Air Force, in charge of a special projects group which attempts to solve problems related to the use of aviation fuels and engines as they are encountered by Air Force personnel. He holds B.S. and M.E. degrees from University of Pittsburgh, and an M.S. in automotive engineering from University of Michigan. Col. Hubner was with Chevrolet Motor Car Co. one year as test engineer, Universal Oil Products Co. for ten years, first as an automotive engineer and later as director of its automotive and aircraft department. He joined Ethyl in 1939 as director of the refinery division and entered the Army Air Forces in 1942.

Lt. L. D. Reis is with the Petroleum Inspection Staff of the Bureau of Ships, a group responsible for the inspection and testing of all petroleum products used by the Navy in the New York area for shipment abroad. He graduated in civil engineering from Iowa State University, had three years' experience with building construction firms in Dallas before joining Ethyl in 1936. With Ethyl he was first a field representative in Arkansas and later safety engineer with the Tulsa Division before entering the Navy in 1943.

Major Russell Schell now is attached to the Office of Chief U. S. Engineers, in charge of the gasoline section, fuel branch, repairs and utilities department, Construction Division. Graduating from the U. S. Naval Academy, he served Marmon Motor Car Co. for two years before joining Ethyl as a field representative in Texas in 1929. In 1934 he became assistant to the manager of the safety department, which position he retained until his Army service began in 1942.

Tech. Sergeant E. J. Staffel is with a Quartermaster Corps petroleum products laboratory stationed in New Guinea. A former gasoline technician at the Yonkers testing laboratory, he joined Ethyl in 1941 after serving several years with the Consolidated Edison Co. He majored in chemical engineering at Brooklyn Polytechnic Institute. Sgt. Staffel has been in the Army since 1943.

Lt. Charles D. Towery is engaged in petroleum inspection for the Bureau of Ships, and is stationed on the island of Curacao, off the Venezuelan coast. He graduated in chemical engineering at Texas A. & M College, spent seven years in laboratories and operating department of Pure Oil Co. before joining Ethyl for one year as a safety engineer, Indiana territory.

Lt. Col. Hubner

Lt. Reis

Lt. Col. Stonewall J. Warner, Jr., is serving as a fuel technologist with the Invasion Forces in Europe. As P.O.L. officer, headquarters, Southern Base Section, Army Service Forces, Col. Warner is in charge of storing all gasoline, oil

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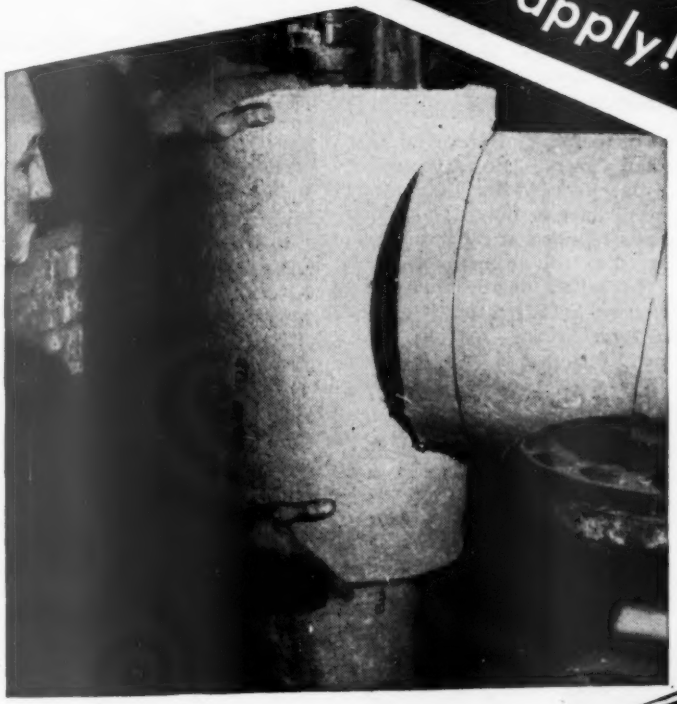

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and ground force troops in overseas operations and directs training of gasoline supply companies. He planned and supervised construction of all petroleum storage depots in the United Kingdom, the first field laboratory for testing of petroleum products and a complete plant for the salvage and repair of 5-gal. gasoline cans. He was once a CCC camp commander.

Col. Warner holds a B.S. degree from Georgia School of Technology and took a year of graduate study at Yale. He was associated with Rauschenberg, Inc., in Atlanta as an inland marine inspector; the Railway Audit & Inspecting Co. in Atlanta as sales manager, and the General Exchange Division, General Motors Corp. as Mobile (Ala.) branch manager. He joined Ethyl in 1938 as a field engineer for Tennessee and entered the Army in 1941.

Tech. Sgt. Staffel

Major Schell

Lt. (j.g.) **Eugene J. Ziurys** is engaged in engine research on fuels and lubricants, U. S. Naval Experiment Station, Annapolis. Born in Connecticut, his early days were spent in Lithuania, where he graduated from Ausros Gymnasium. He holds B.S. and M.E. degrees in mechanical engineering from Yale University. Lt. Ziurys joined Ethyl in 1935 as a research engineer, leaving to join the Navy in 1942.

Socony-Vacuum Oil Co., Inc.

Lt. (j.g.) Edward Albat, now petroleum adviser to the Naval Attache on Bahrein Island and formerly instructor in the Philadelphia Naval Yard's Boiler and Turbine Laboratory, worked four years for Socony-Vacuum before active duty in the Navy. He completed his education in 1940 with a master's degree in chemical engineering from University of Michigan. With Socony, he was in the Technical Service Division, chemical engineering group, worked on the *Technical Data Book,* survey of operations, and on the design of Neches Butane Products Co. butadiene plant at Port Neches, Texas.

Major R. J. DeGray is in the Technical Service Division of Army's Chemical Warfare Service. He has worked on the development of incendiary bombs and flame throwers, served nine years with Socony-Vacuum before being released for military duty. He was assistant supervisor in charge of the analytical development group, Technical Service Division, General Laboratories. Major DeGray has a doctor of philosophy degree from Columbia University.

Robert J. Flemming, Sp (0) 2/c, now is enlisted aid to the Resident Naval Inspector at the Richmond refinery, Standard Oil Co. of California. Four of his six years with Socony-Vacuum's Technical Service Division were as an oil tester in the physical testing group, the other two years as test engine operator in the automotive group. He completed his sophomore year in college.

Lt. (j.g.) Francis W. Giaccone is at present attached to the Fuels and Lubricants Division, Aircraft Engine Laboratories, Philadelphia Navy Yard. Completing his college work with a degree in mechanical engineering in 1941, he was employed in the general laboratories at Paulsboro, N. J., as a mechanical engineer in the automotive section. He received specialized training in engine testing technique, including operation of various commercial engines of automotive, aviation and Diesel type as well as numerous single-cylinder engines and small laboratory testing apparatus used in determining service life and other data on newly developed fuels, lubricants and additives.

Staff Sergeant W. T. Hergrueter now is attached to a mobile petroleum testing laboratory operated by Army Engineers near the front lines in Italy. This group tests products received at the front from supply depots, as well as enemy supplies. Having a bachelor's degree from New York University, Sgt. Hergrueter worked four years with Socony Vacuum's analytical group, Technical Service Division, on the analysis of oils and greases before going on military leave.

Lt. (j.g.) C. W. Hoffman is Naval Petroleum Inspector, Office of Inspector of Navy Material, Houston. He is a graduate of New York University with a bachelor of science in chemistry. Lt. Hoffman worked ten years with the Technical Service Division, analyzing oils and greases for the analytical group.

Lt. Towery

Lt. Col. Warner

Technical Sergeant Fred Karn is attached to the Quartermaster Department, stationed in a petroleum laboratory at an advanced South Pacific supply depot. His duties are to test the petroleum products received at the depot and also captured petroleum supplies. He received a bachelor degree in chemistry from Carnegie Institute of Technology. With Socony's Technical Service Division for five years, he has worked for the products development group on various problems in connection with the manufacture of waxes.

Sergeant W. H. Kracke received training at Camp Lee, Va., to be assigned to Quartermaster Petroleum Products Laboratory at some advanced supply depot. His duties will be to test petroleum products received from the U.S.A. and in captured supplies. Sgt. Kracke worked in the Technical Service Division, physical testing group, for 14 years and for two years was in charge of preparing experimental blends of fuels and oils for engine evaluations. He completed one year at Columbia University.

Lt. Ziurys

Major DeGray

Staff Sergeant T. W. Posener is attached to the Army Engineers at a mobile testing laboratory near the Front "somewhere in Italy." Completing high-school, he worked in the physical testing group, Technical Service Division, as an oil tester for two years before going on military leave. His duties in the Army's laboratory include the checking of petroleum supplies shipped in from the U. S., as well as material captured from the Germans.

Major M. S. Trumble is with the Army Engineers, at present in India with headquarters of an Engineer Petroleum Distribution Unit, where he has contact with supply, operation and maintenance of the unit and the supervision of a mobile petroleum testing laboratory. He was with the Development Section of the General Laboratories at Paulsboro as a chemical engineer for little over a year, joining immediately upon graduation from the University of Michigan, where he received B.S. and M.S. degrees in chemical engineering. Before he had time to complete the usual training course given new men, he was ordered to active duty as a second lieutenant, Ordnance Reserves. By the time he left Aberdeen Proving Grounds for overseas he was assistant executive officer in the Planning Section, Automotive Test and Research Division.

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(*Continued from p. R-416*)

3—To segregate the C_4 fraction for alkylation feed.

4—To rerun the 400° F. e.p. catalytically cracked gasoline to 330-340° F. base stock.

5—To segregate the C_5 fraction for aviation gasoline blending or charging to the alkylation unit.

Catalytically cracked gasoline of 400° F. e.p., high pressure catalytic and thermal gas, and high pressure compressor condensate gas are charged to the deethanizer.

This is a 4 ft. by 60 ft. column containing 28 trays and operating as a combination absorber and stripper. Catalytic naphtha is circulated over the top at the rate of 15-20 gals./min. as the absorption medium, and cooling is supplied at the center of the column by circulation of liquid from a reservoir between the 13th and 14th trays, through an intercooler and back into the next tray below at the approximate rate of 50-75 gal./min.

The bottom temperature is maintained at 200° F. by an external steam heated reboiler; top temperature is 100° F. The column is operated at 200 lbs. pressure. Ethane and lighter gases are removed overhead and go directly to the fuel gas system.

The bottoms, consisting of C_3 and heavier hydrocarbons boiling up to 400° F., are charged to the depropanizer, which also receives a low pressure condensate from the catalytic cracker and stabilizer overhead condensate from the thermal cracker.

The depropanizer is a 6½ ft. by 53 ft. column containing 30 trays and operating at 250 lbs. pressure. Top temperature is maintained at 110° F. by refluxing with part of the overhead condensate at the ratio of 4-5:1, and the bottom temperature is held at 280° F., with heat supplied by an external steam heated reboiler. The propane-propylene overhead fraction may be charged to the polymerization unit, the alkylation unit, or released as a gas to the fuel system. Bottoms, consisting of C_4 and heavier fractions boiling up to 400° F., flow to the debutanizer under system pressure.

The debutanizer is a 6 ft. by 69 ft. tower with 28 trays operating at 50-100 lbs. pressure. Top temperature is maintained at 130-145° F. by refluxing a part of the overhead condensate at the ratio of 1-2:1; bottom temperature is maintained at 325° F. by an external steam heated reboiler, using 275-lb. steam.

The BB fraction recovered overhead, consisting of isobutane, normal butane, and butylenes, is caustic washed. This fraction is the normal feed to the alkylation unit. The bottoms from this tower, consisting of C_5 and heavier hydrocarbons boiling up to 400° F., flow under system pressure to the rerun column.

The rerun column is 6½ ft. by 38 ft. with 20 trays, operating at 5 lbs. pressure. Top temperature is maintained at 225° F. by refluxing part of the overhead condensate at a ratio of 1-2:1, and bottom temperature is held at 370° F. by means of an external steam heated reboiler. The overhead is 330-340° F. e.p. debutanized base stock which contains all of the catalytic C_5 fraction.

The bottom stream is 330-400° F. catalytic naphtha, part of which is pumped over the top of the deethanizer as absorber oil while the remainder goes to storage, later to be blended with the thermally cracked and reformed gasoline. The overhead from the rerun column, after passing through a caustic scrubber, enters the depentanizer.

The depentanizer is a column 5 ft. by 76 ft. with 40 trays, operating at 25 lbs. pressure. Top temperature is maintained at 140°F. by refluxing part of the overhead condensate at a ratio of 2-3:1. Bottom temperature is held at 250° F. by means of an external steam heated reboiler.

The overhead is C_5 fraction which goes to storage. The bottom stream is depentanized catalytic base stock which represents about a 20% yield on the gas oil-kerosine charge to the cat cracker. The caustic-treated base stock is inhibited with UOP inhibitor, either No. 4 or No. 5, blended with alkylate and isopentane, ethylized to make 100 octane gasoline.

HF Alkylation Unit

While the Fluid catalytic cracking process is the major producer of the components of 100-octane gasoline, the alkylation process is really the key to 100-octane gasoline yield, because the quantity of alkylate available usually governs the quantity of aviation gasoline that can be made.

The fact that the new facilities at the Pennzoil plant today are producing 150% of the originally estimated output of 100-octane gasoline is largely due to modifications made in the operation of the alkylation unit which made possible the utilization of additional C_3 and C_5 fractions as feed stock for alkylation. (See Table 3.) These modifications will be explained later.

TABLE 3

Alkylation Feed Stock

Olefin	%
Propylene	2.8
Butylenes	73.4
Amylenes	23.8

The catalyst used in the process is anhydrous hydrogen fluoride, which is a liquid under a few pounds pressure. The process is divided into four main

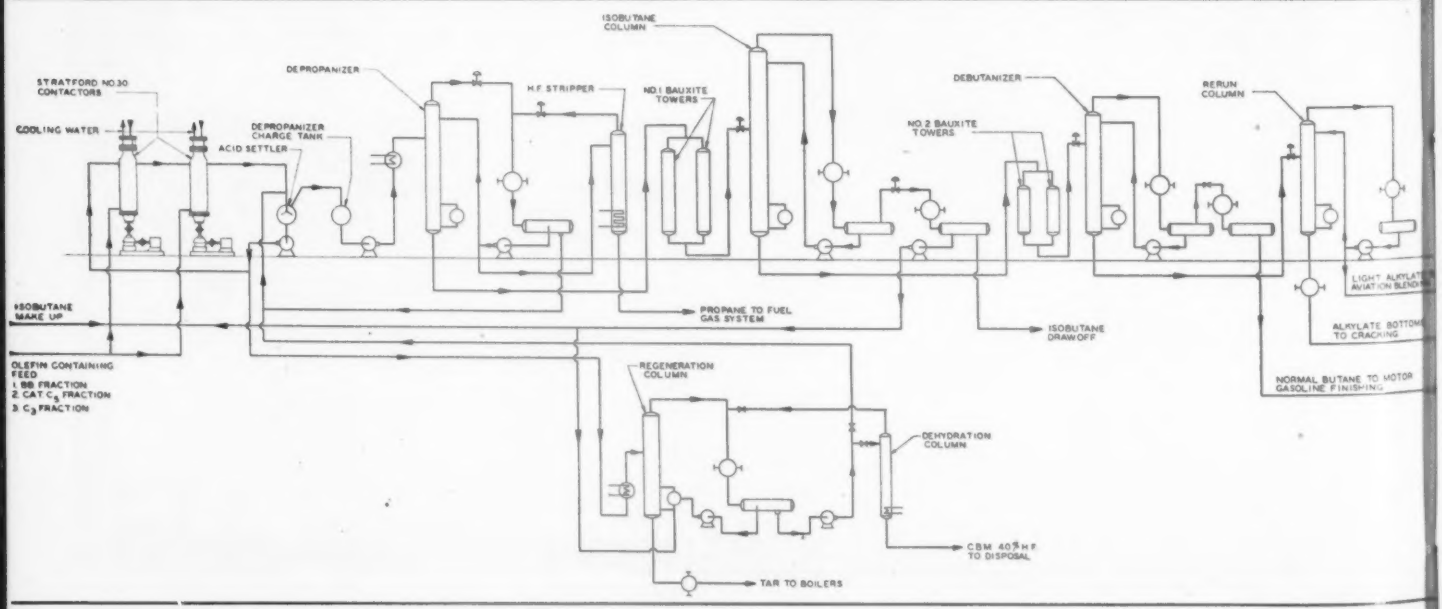
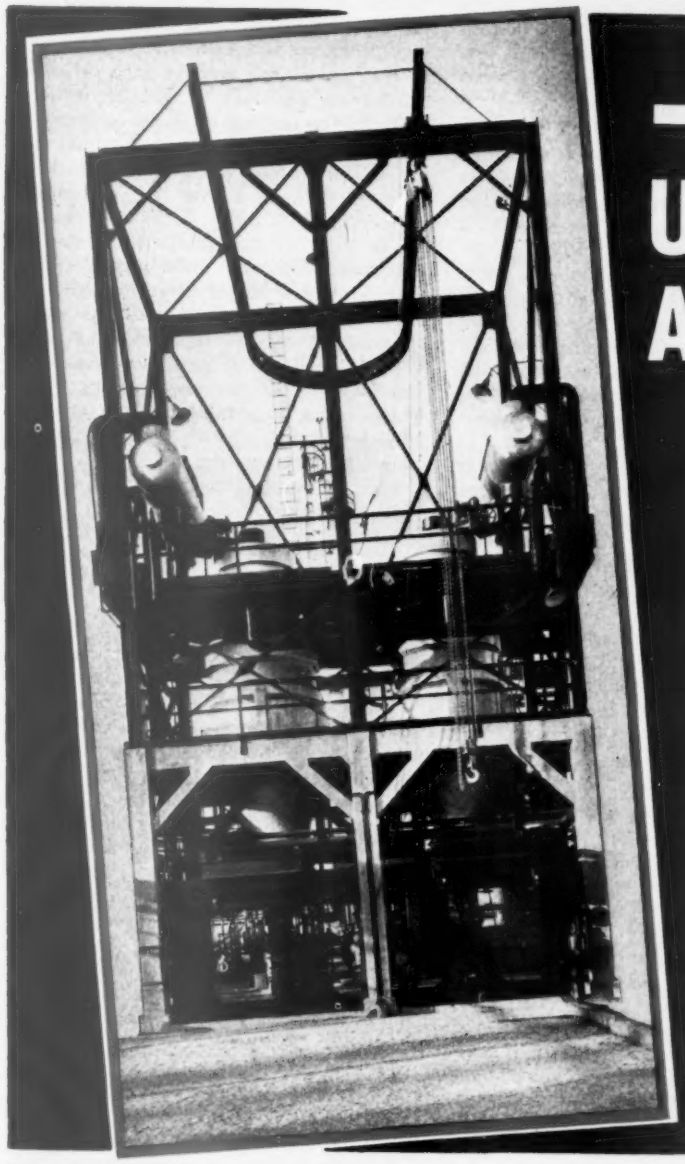


Fig. 4—Flow chart for the HF alkylation unit

More Than 100 STRATCO CONTACTORS



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sections, as follows: Feed preparation, contacting, fractionation, and acid regeneration.

The olefin-containing feed recovered in the gas concentration unit is charged from intermediate storage through the feed dryers which are three 2 ft. by 14 ft. towers filled with a commercial desiccant, manifolded to permit the use of two towers while the third is being regenerated. The feed flows directly from the dryers to two No. 30 Stratco contactors.

The contactors are manifolded for parallel flow of the olefin-containing feed, and for series flow of the isobutane recycle and acid, the effluent from No. 1 contactor passing to No. 2. In recent operations it has been found advantageous to dry all or part of the isobutane recycle by passing it through the dryers along with the BB feed. Thus a part of the isobutane recycle also passes to the contactors in parallel.

The alkylation unit was designed for 6:1 ratio of isobutane to olefin, based on the total feed to the contactor (fresh feed plus isobutane recycle) and the space time was 30 minutes. The throughput has been increased to the point where the yield of alkylate is nearly twice the design production.

The high throughput has reduced the isobutane:olefin ratio to as low as 3-4:1 and the space time to 15-20 min., and has resulted in only slight sacrifice in quality of the alkylate.

Intimate mixing of acid and hydrocarbon takes place in the contactors, which operate at a pressure of 85 to 125 lbs. Since heat is generated in the reaction, the contactor is provided with a tube bundle through which water circulates. The tubes are G-fin; the fin has an outside diameter of 3.37 in. The tubes are seamless steel, 1½ in. in diameter. Temperature in the contactors is maintained at 75-100° F. Space time is 15 to 30 min.

From the contactors, the acid-hydrocarbon mixture goes into the acid settler, a horizontal 8 ft. by 30 ft. vessel provided with baffles, where it separates into acid and hydrocarbon phases. The hydrocarbon phase is drawn from the top of the settler into the depropanizer charge drum, a 3 ft. by 30 ft. vessel. Feed to the depropanizer is pumped from this drum through a preheater in which its temperature is raised to about 180° F.

The depropanizer, a 5 ft. by 40 ft. tower with 35 trays, operates at 300 lbs. pressure. Top temperature of 125° F. is maintained by refluxing a portion of the overhead condensate at a ratio of 20-30:1, and bottom temperature is held at 240° F. by means of an external steam-heated reboiler.

Because the propane overhead stream contains some free acid, it is pumped to a stripper for separation of propane and acid.

Hydrogen fluoride dissolved in hydrocarbons has an abnormally high volatility; this fact is made use of in the HF stripper which is a 1½ ft. by 27 ft. fractionating column packed with 20 feet of ½ inch carbon Raschig rings. The charge is fed near the top. An internal steam coil at the bottom supplies the heat necessary for stripping; i.e., 125° F. at the top and 140° F. at the bottom.

A portion of the propane feed, together with all of the free HF, passes overhead into the depropanizer vapor line. The remainder of the propane passes from the bottom of the stripper through a small drum filled with limestone and thence to the fuel gas system. Acid recovered in this system collects in a leg on the depropanizer receiver from which it is returned to the settler.

One of the primary advantages of the HF alkylation process is the ease with which the concentration of acid in the system is maintained by continuously withdrawing less than 2% of the circulating acid for regeneration. This procedure keeps the acidity at the desirable 90-95% operating strength; thus avoiding the problems involved in reconcentrating or disposing of large quantities of spent acid.

The small stream for regeneration is withdrawn from the main acid stream circulating from the acid settler to the contactors. Regeneration involves two steps; first, the removal of any polymer or tar formed in the reaction; second, the removal of water.

The first step is accomplished in the regenerator, which is a 3 ft. by 30 ft. tower with 6 side-by-side pans below the feed line and 1 foot of carbon Raschig rings. The tower operates at 90 lbs. pressure and at a temperature of 242° F.

The HF is flashed overhead by introducing stripping isobutane through a superheater operated at 360° F. Polymer or tar is withdrawn from the bottom of the column and sent to the boiler fire-boxes. The greater part of the acid overhead is returned to the settler along with the stripping isobutane. A small portion of the acid overhead is charged to the dehydration column, in which the water is removed from the bottom as a constant boiling mixture containing about 40% acid. The constant boiling mixture is disposed of by neutralization with lime and precipitation of the calcium fluoride. The acid overhead is returned to the settler along with the overhead from the regeneration column.

The dehydration column is 25 ft. high. The lower 10 ft. is steam jacketed and has an inside diameter of 18 in. The upper part is 14 ft. high, with a 14 in. diameter, and is filled with ½-in. carbon Raschig rings. This column is operated at 100 lbs. pressure, with a top temperature of 175° F. and a bottom temperature of 300° F.

The hydrocarbon stream leaving the bottom of the depropanizer contains a small amount of combined fluorides, which are removed by passing this stream through bauxite at 200-240° F. and 290-300 lbs. pressure. The bauxite is contained in two towers, each 4½ ft. by 25 ft. The towers are manifolded to permit flow through one tower while the other is being dumped and refilled.

The hydrocarbon stream from the bauxite tower flows to the deisobutanizer, a 7 ft. by 110 ft. tower, containing 50 trays and operating at 100 lbs. pressure. Overhead vapors from this column are partially condensed and passed into an accumulator from which reflux is returned to the top of the column at a ratio of 2-2.5:1 to maintain a temperature of 120° F. The net overhead passes through a secondary condenser into the final receiver from which the isobutane recycle is returned to the contactors. A bottom temperature of 250° F. is maintained by an external steam-heated reboiler.

Bottoms from the deisobutanizer are charged to the debutanizer, which is a 3 ft. by 47 ft. column with 25 trays operating at 80 lbs. pressure. Overhead from this column is partially condensed and passed into an accumulator from which reflux is returned at a ratio of 3.5-4:1 to the top of the column to maintain a temperature of 135° F.

The net production passes through a final condenser into a receiver from which normal butane is pumped to storage to be blended later with the cracked and reformed gasoline to bring its vapor pressure up to specifications. The bottom temperature is maintained at 325-350° F. by an external steam-heated reboiler.

The bottoms from the debutanizer flow under system pressure to the rerun column, a 3½ ft. by 42 ft. tower containing 20 trays and operating at 5 lbs. pressure. A top temperature of 225° F. is maintained by refluxing with a part of the overhead condensate from the receiver at a ratio of 0.1-2:1. The bottom temperature of 350-375° F. is maintained by an external steam-heated reboiler.

The overhead from this column is the finished aviation alkylate fraction having characteristics as shown in Table 4.

TABLE 4

Quality of Alkylate

Octane Rating	
A.S.T.M., clear	91.1
AFD 1 C, + 4.6 cc TEL	108.0
AFD 3 C, + 4.6 cc TEL	S+2.46
90% boiling point, °F	238
Endpoint, °F	294
Reid V.P., lb.	6.5

This material goes to intermediate storage and subsequently is blended into aviation gasoline. The bottoms from the rerun column, amounting to less than 10% of the total alkylate, are charged to the catalytic cracking unit for further recovery of material boiling below 330-340° F. and cracking of fractions boiling above 400° F.

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cedure which increased the production of 100-octane gasoline by more than 50% over what was expected consisted of taking full advantage of the flexibility and versatility, not only of the alkylation unit, but of the "cat cracker" and the gas concentration system as well.

The operation was changed in several ways, namely:

1—The catalytic cracker was operated to produce more olefins without appreciably reducing the quality of the base stock.

2—The gas concentration depentanizer was changed to an alkylate debutanizer to remove a bottleneck in the alkylation operation.

3—The gas concentration debutanizer was operated as a depentanizer, removing all the BB and C_5 fractions overhead. Thus the catalytic C_5 fractions containing about 30% amylenes could be charged to the alkylation unit along with the BB feed.

4—Isobutane was obtained from outside sources where there was an excess over local requirements, to make up the deficiency, inasmuch as it takes 1¼ bbls. of isobutane to 1 bbl. of olefin to produce alkylate.

5—The increased production of aviation gasoline led to a shortage of isopentane. Isopentane is blended to increase the vapor pressure of 100-octane gasoline. Arrangements were made to obtain about 200 b/d of isopentane, containing about 30% olefins, from another refinery. This material is now charged to the alkylation unit to increase alkylate production and to make up vapor pressure deficiency.

In order to obtain a depropanizer overhead fraction free of all C_2 and lighter hydrocarbons, the low pressure condensate and thermal overhead condensate are to be charged to the deethanizer instead of to the depropanizer of the gas concentration unit. Preliminary operation has already indicated that a C_2-free depropanizer overhead fraction rich in propylene can be recovered with no appreciable increase in BB loss in the deethanizer.

The possibility of installing an isomerization unit in conjunction with the other operations was investigated. However, the production of normal butane in the cracking operations is only sufficient to meet vapor pressure requirements of the motor gasoline and there is not enough casinghead gasoline available to the refinery to make up vapor pressure specification.

Utilities

The utilities provided in connection with the operations include a 150,000 lbs./hr. steam plant and an induced draft cooling tower.

The steam plant consists of three boilers, each designed to produce 50,000 lbs. of steam per hour, at 275 lbs. pressure. A feature which is novel in a western Pennsylvania refinery boiler plant is the use of powdered coal burning equipment. It combines the advantage of using the cheapest fuel available in the area with the flexibility usually expected only with gas or oil firing. Not only does the boiler plant supply all the steam needed in Plant 3, but it also pipes a considerable quantity to Plant 2.

Another innovation in the area is a 6-section induced draft cooling tower. It was designed to cool 10,000 gals. a min. from 110° F. to 85° F. at 75° F. wet bulb, thus assuring an ample supply of water at low temperature for cooling and condensing purposes and minimizing the amount necessary to be drawn from Oil Creek, which is not a dependable source of inexhaustible supply. Loss of water through the system is only about 5%.

Other facilities include an inhibiting system, blending tanks, an Ethyl plant equipped to handle Ethyl fluid in tank car lots, safety building with first aid room, time and change house, shop and complete laboratory for testing products.

At every stage of planning and construction of this aviation gasoline refinery, the designers and builders, as well as the joint owners, were constantly mindful of the need to save every possible pound of critical materials, every possible item of critical equipment.

Every requisition was carefully scrutinized; substitutions were made wherever feasible. Every economy was effected that could be justified from the standpoints of safety and efficient operation.

The plant is considered to be paying good dividends in 100-octane gasoline produced. How about the dividends in lives saved? How many extra blockbusters will crash down on Tokyo to shorten the war? How many American flyers will come safely home because of those thousands of barrels of 100-octane gasoline that four Pennsylvania refiners put up a fortune to produce?

Hydrocarbon Reference Samples Are Listed

THE rising need for reference samples of pure hydrocarbons, for use as standards of known high purity in the calibration of analytical instruments in the research and analytical laboratories of the petroleum, rubber, chemical and allied industries has resulted in the National Bureau of Standards preparing a group of hydrocarbons of certified purity. The increased use of such instruments as the mass, ultraviolet, and infrared spectroscopes in 100-octane gasoline and butadiene plants during the war has intensified the need for reference standards.

The first group of samples, representing 15 hydrocarbons, was made available in January, 1944. Now 19 different hydrocarbons are available in 46 standard samples. Each sample is accompanied by a certificate showing the amount of impurity and method of determination. The samples are prepared by the Bureau from commercial material of original high purity.

In the list of 19 different hydrocarbons now available, purities range from 0.012 ± 0.007 mol-% to 0.36 ± 0.18 mol-%. Sample sizes, depending on the individual hydrocarbon, are 5, 8 and 25 ml.; one hydrocarbon only is available also in 50 ml. samples. Samples in the 5, 25 and 50 ml. size are contained in plain ampoules of pyrex glass, sealed in vacuum; the 8 ml. size is a special ampoule with internal vacuum break-off tip. Prices now range from $10 to $35 depending on size of sample; the 50 ml. size costs $60.

Nineteen of the available hydrocarbon samples are shown in the table below, together with amount of impurity.

Three samples, methylbenzene (toluene), 2,2,4-trimethylpentane and methylcyclohexane, now are certified with respect to value of refractive index and density. One of these, 2,2,4-trimethylpentane, also is certified for calorimetric heat of combustion.

Name	Approx. Impurity mol—%
n-Pentane	0.25 ± 0.10
2-Methylbutane (isopentane)	0.13 ± 0.10
n-Hexane	0.24 ± 0.09
2-Methylpentane	0.25 ± 0.10
3-Methylpentane	Undetermined*
2,2-Dimethylbutane	0.10 ± 0.04
2,3-Dimethylbutane	0.06 ± 0.04
n-Heptane	0.10 ± 0.05
2,2,4-Trimethylpentane	0.12 ± 0.05
Methylcyclopentane	0.25 ± 0.09
Cyclohexane	0.012 ± 0.007
Methylcyclohexane	0.36 ± 0.18
Benzene	0.05 ± 0.02
Methylbenzene (toluene) (2 samples)	0.04 ± 0.02
Ethylbenzene	0.20 ± 0.07
1,2-Dimethylbenzene (*o*-xylene)	0.14 ± 0.05
1,3-Dimethylbenzene (*m*-xylene)	0.17 ± 0.07
1,4-Dimethylbenzene (*p*-xylene)	0.07 ± 0.03
Isopropylbenzene (cumene)	0.07 ± 0.03

* Believed to approximate 0.25 ± 0.10.

The values for refractive index and density are given to within ± 0.00002 g. per ml. at 20°, 25° and 30° C. for air-saturated material at one atmosphere. Those for refractive index to ± 0.00002 at each of seven wavelengths: helium 6678 and 5016, hydrogen 6563 (C) and 4861 (F), mercury 5461 (e) and 4358 (g), and sodium 5893 (D).

The certification for calorimetric heat of combustion, with values applicable to a bomb calorimeter, in the instance of 2,2,4-trimethylpentane, is primarily for use in establishing heating values of gasoline and other volatile liquid fuels. This sample is available in a special 50 ml. ampoule in addition to the usual sizes.

263-Ton Hortonsphere Built on Timber Bed, Moved 800 Ft. Intact

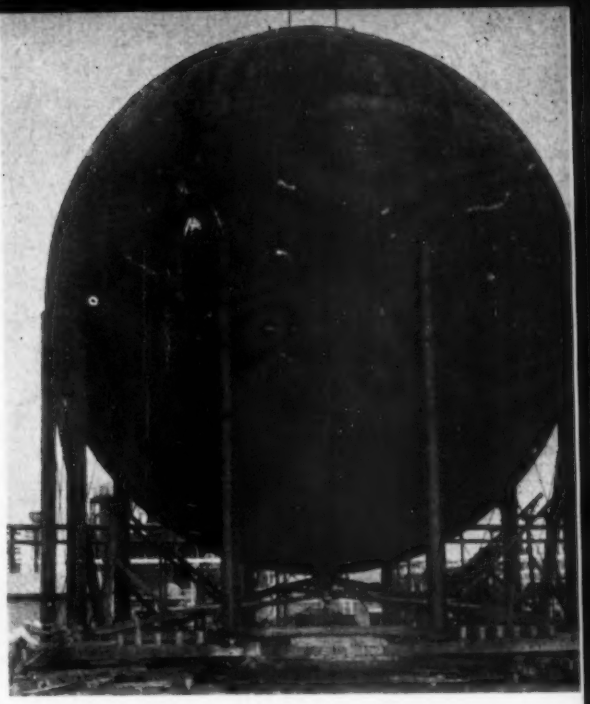


Fig. 1—263½-ton Hortonsphere, resting on the timber bed where it was built by Chicago Bridge & Iron Co., starts on 800-ft. trip to its final resting place in Humble's Baytown refinery. Unusual moving procedure was necessary because gassy atmosphere prohibited welding at permanent site

IT IS NOT often that a big steel tank is moved bodily to a new location, especially one which weighs—as moved—in the neighborhood of 260 tons. But this unusual job was recently completed by the Chicago Bridge & Iron Co. at the Baytown, Tex., plant of Humble Oil & Refining Co. This unorthodox procedure was necessary because the hazards of a gassy atmosphere at the desired tank location forbade any welding during fabrication. So the Hortonsphere was built on a temporary timber bed and moved, completed, 800 feet to its permanent location; to complicate the job, a right-angle turn had to be made around existing structures.

The sphere is 51¼ ft. in diameter, has a capacity of 12,525 bbls., and was designed to store isobutane at 75 p.s.i. pressure. It is supported on 10 H-section posts, eight of which rested directly on the rectangular timber bed while the other two were outside, as shown in the accompanying illustrations. These latter posts were supported during erection and moving by sloping 12 in. by 12 in. timbers with the upper end fitted into the pocket formed by the attachment of the posts to the shell and the lower end supported by the timber bed.

Posts Braced for Added Safety

The timber bed, which supported the posts, was made of 6 in. by 8 in. timber struts between adjacent posts, with spider rods tying the bottoms of the posts to a spider ring under the center of the sphere. To give an added safety factor, the four posts at, roughly, the corners of the timber bed were braced against the neck of the bottom manhole with 6 in. by 8 in. timbers. The various wooden members were bolted together with gusset plates.

The sphere was fabricated directly on the timber bed. The bolts on the base plates were arranged in the corresponding relative position occupied by the anchor bolts on the permanent foundation. Thereafter, the tank was constructed just as it would have been normally on a permanent foundation. The job of locating these temporary anchor bolts was so good that, when the tank did arrive at its permanent location the post base plates lined up with the foundation anchor bolts without difficulty.

While the sphere was being built, a road was constructed of timber tracks laid on 3-in. wooden planking. At the point where the 90°-angle turn was to be made, the roadway was built to make a wide turn (*see Figs. 2 and 3*).

Timber Bed Reinforced

Before moving, the timber bed was reinforced by two lengths of ⅝-in. steel cable on each side and other lengths bridled across the ends. The pulling hitch was attached to the front corners of the bed. Two sets of ⅝-in. triple blocks, full reeved, were used to move the sphere, one of the blocks in each set being connected to the pulling hitch

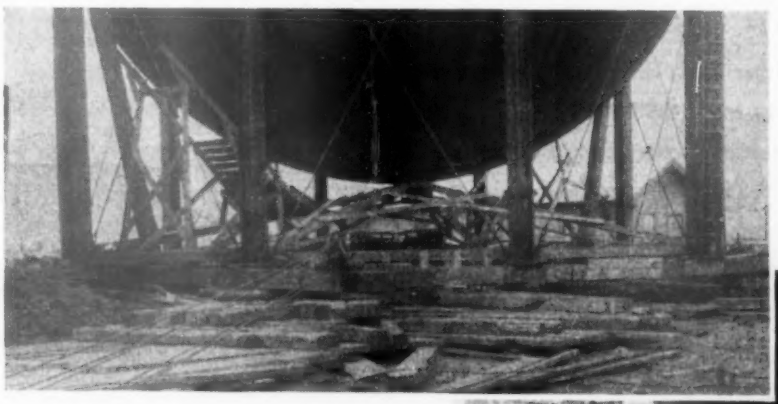


Fig. 2 (Above)—Details of the hitch used to tow the 12,500-bbl. sphere are visible in this picture, made while it was rounding a right-angle bend on timber runway. Angular support for the two posts extending beyond timber bed are visible at left and right background

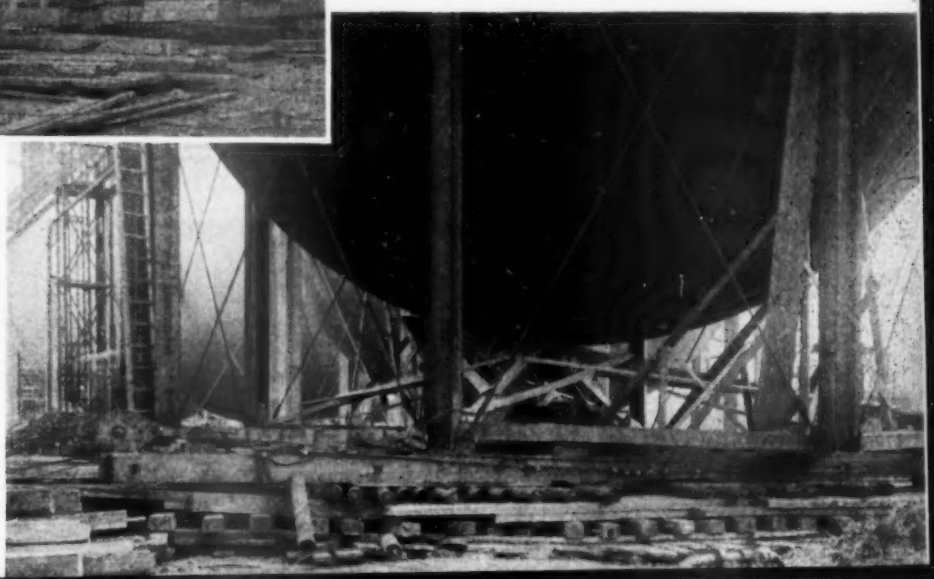
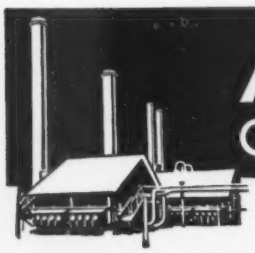


Fig. 3 (Right)—Bracing details are best shown in this photograph, which also shows rollers and supports. Other tanks are visible in background

Research has mothered many industries and not the least is petroleum refining. The cumulative research of the industry, Alcorn's specialized research and engineering applications have combined for 21 years to meet the constantly changing requirements for heating hydrocarbons. Alcorn installations have resulted in many notable instances of greater production at lower costs.

Alcorn has developed a standardized line of heaters ("J" Type) with capacities ranging from 8,000,000 to 40,000,000 B.T.U.'s. The "J" type heater is a standardized design and priced accordingly. Its cost is far less than a plant engineered heater and results are decidedly better. Adapted for topping units, re-run units, natural gasoline, absorption and recycling units.

For new installations, consultation with Alcorn may point the way to peak production with economy.



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R-488

and the other tied to the forward end of the runway. Live ends of the two block lines were attached to a set of ⅜-in. triple blocks reeved full and pulled by a hoist.

A triple-drum hoist was placed at the rear of the sphere during the moving operation, ready to pull backward if the structure started settling forward during moving. The hoist made it possible to reverse the movement at will and was helpful when the rollers stuck or were not aligned.

When the assembly reached its permanent location, the timber bed was removed and the structure lowered onto the foundation with screw-type jacks. Thereafter, all that remained to complete the job was to connect the pipes, insofar as construction work was concerned. Total moving time was 12 working days.

Acknowledgement is made to The *Water Tower*, published by the Chicago Bridge & Iron Co., for permission to publish data and photographs.

TECHNICAL MEETINGS FOR OIL MEN

In response to recent government requests, many technical societies have cancelled or postponed their usual annual and semi-annual meetings. To the extent that we have the information available, the listings below give the meetings which had already been scheduled and their present status.

JUNE

18-21, Amer. Society of Mechanical Engineers, Semi-Annual Meeting, Chicago. **(Postponed)**
18-22, Amer. Society for Testing Materials, 48th Annual Meeting, Hotel Statler, Buffalo.

SEPTEMBER

10-14, Amer. Chemical Society, Annual Fall Meeting, Chicago. (ACS has cancelled its regular Spring meeting.)
(No date), National Lubricating Grease Institute, Edgewater Beach Hotel, Chicago.

OCTOBER

15-23, Amer. Society for Metals, Philadelphia **(Tentative)**

Refresher Book Is Popular

Unexpected demand from both servicemen and civilian refining technologists has required a second printing of the *Refresher on Wartime Refining Technology*—a book prepared by the technical editors of NPN primarily to help refinery men in the armed services catch up quickly on wartime technical developments.

Like the first printing, the new supply will be available on a complimentary basis to refining technologists who are or have been in the armed services of the United States; and to civilians at $1.25 each.

Reactions often go awry if there's moisture in materials being processed. That's why plant designers provide dryers, working on-stream, charged with Activated Aluminas—to help make certain that reactions stay on the straight and narrow path.

Alorco Activated Aluminas dry air, gases and many organic liquids to dewpoints below –110° F. One charge usually lasts for years. Standard machines are available which reactivate the drying agents as they become laden with moisture, assuring an uninterrupted flow of dry materials.

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Semi-Annual INDEX of Refining Technology Articles

JANUARY—JUNE, 1945

Subject Index

Subject	Article	Issue	Page
Additives			
	Chlorinated Paraffins (KU)	May 2	R-363
	Engine Oil Foaming	May 2	R-379
	Petroleum Sulfonates (KU)	Apr. 4	R-292
	Survey of Past and Present Trends in Lubricating Oil Additives	Jan. 3	R- 34
Aircraft			
	Aeronautical Gas Turbines (KU)	Jan. 3	R- 48
	Postwar Aircraft (KU)	Apr. 4	R-288
	Postwar Private Planes (KU)	June 6	R-454
	Rocket Planes (KU)	Apr. 4	R-283
Alcohol as Fuel			
	Power Alcohol (KU)	Mar. 7	R-210
	Research, or Medicine Show, on an Automotive Development (Ed)	Apr. 4	R-320
Alcohol-Water Injection			
	Alcohol Tested as Injection Fluid for Gasoline Engines (Ed)	Feb. 7	R-160
	Alcohol-Water Injection as a Detonation Depressor in Gasoline Engines	Feb. 7	R- 88
	Discussion on Alcohol-Water Injection	Apr. 4	R-249
	Obstacles Seen to a Two-Fuel System for General Use on Automobiles	Apr. 4	R-249
	Research, or Medicine Show, on an Automotive Development (Ed)	Apr. 4	R-320
	Water Injection Alone Suppressed Detonation but Excessive Engine Rusting Was Found	Apr. 4	R-250
Alkylation			
	Alkylation—Backbone of Aviation Gasoline	June 6	R-407
	Mechanical Operation of HF Alkylation Units	May 2	R-326
Ammonia (see Synthetic Ammonia)			
Automobiles (see Postwar Automobile)			
Automotive Laboratories			
	New Devices Save Time and Labor in Setting Up Engine Test Stands (Sun Oil Co., Marcus Hook, Pa.)	Apr. 4	R-257
Aviation Gasoline			
	Alkylation—Backbone of Aviation Gasoline	June 6	R-407
	Chemical Utilization of Natural Gas	June 6	R-430
	Evaporation Losses of Aviation Gasoline in Standing Storage: Part 1—Tests with Blended Aviation Gasoline	Apr. 4	R-252
	Part 2—Tests with Blending Stocks	May 2	R-373
	Maximizing Output from Wartime Plants Heads Refiners' Program for 1945	Mar. 7	R-163
	New Plant Facilities Boost Aviation Gasoline Production Fifteen-Fold	Mar. 7	R-174
Butadiene			
	Condensation of Ethylene with Acetylene	Mar. 7	R-224
	Cooling Water and Effluent Treatment in Butadiene Manufacturing	Apr. 4	R-273
	Kinetics of the Process of Thermal Polymerization of Butadiene	June 6	R-466
	New Chemical being Produced in Kobuta Butadiene Plant	Mar. 7	R-206
	Petroleum Butadiene (KU)	Jan. 3	R- 48
	Polymerization of Mixtures of 1,3-Butadiene with 2-Butene and with Pentane by Sodium	Feb. 7	R-133
	Postwar Butadiene Uses (KU)	June 6	R-454
Carbon Black			
	Carbon Black (KU)	May 2	R-363
	Chemical Utilization of Natural Gas	June 6	R-430
Carbon Disulfide			
	Carbon Disulfide (KU)	Feb. 7	R-132
Catalytic Cracking			
	"Cat Cracker" Turn-Around	Apr. 4	R-243
	Converting Thermal Plants to Catalytic Operation (Ed)	June 6	R-496
	Design and Operating Features of Houdry Units	May 2	R-333
	Four Neighboring Refiners Install Joint Catalytic Cracking Unit	June 6	R-410
	Improved Fluid Process for Catalytic Cracking, The	Mar. 7	R-194
	Quality of Distillate Fuel Oils from Houdry and TCC Operations	Mar. 7	R-165
	TCC Catalytic Cracking Process for Motor Gasoline Production, The	June 6	R-441
	24-Tray Water Wash Tower Removes Ammonia and Hydrogen Cyanide from "Cat Cracker" Products	June 6	R-406
	2600 b/d Fluid Catalytic Cracking Unit Proves Successful on Initial 65-Day Run	Feb. 7	R- 83
	Use of Cracked Gas Oils as Burner Fuels Being Tested	Feb. 7	R-124
Chemicals			
	Hydrocarbon Reference Samples Are Listed	June 6	R-486
	New Chemicals being Produced in Kobuta Butadiene Plant	Mar. 7	R-206
	Use of Chemicals by the Petroleum Industry, The	Jan. 3	R- 76
Chemicals from Petroleum (see Petrochemicals)			
Chlorinated Paraffins			
	Chlorinated Paraffins (KU)	May 2	R-363
Control			
	Automatic Control Engineering (BR)	Jan. 3	R- 43
	Program for Loss Control in Manufacturing and Handling Operations	June 6	R-403
Cracking (see Catalytic Cracking)			
Cycling Operations			
	Flow Lines to Each Well Feature Operations of New Cycling Plant	May 2	Cover
	Greater Light-Ends Recovery Is Design Trend in Natural Gasoline Plant Construction	May 2	R-323
	Paloma Cycling Plant Repressures 23 Wells at 10,000-11,000 Feet	May 2	R-337
Dehydration			
	Dehydration of Furnace Oil with Activated Alumina	Jan. 3	R- 63
Dehydrogenation			
	Production of Isoprene by Catalytic Dehydrogenation, The	Apr. 4	R-263
Design (see Plant Design)			
Desulfurization			
	Catalytic Desulfurization Improves Lead Susceptibility of "Sour" Distillates	Apr. 4	R-309
Diesel Engines			
	Dual-Fuel Diesel Engines Use Either Gas or Oil	May 2	R-396
	New Technique for Frame Combustion Photography (Ed)	June 6	R-496
	Railway Diesels (KU)	Feb. 7	R-128
Distillation (see Fractionation)			
Economics			
	Costs of Oil from Coal and Shale	Mar. 7	R-205
	Hydrocarbons for Petrochemicals	Apr. 4	Cover
	Wealth of Hydrocarbons for Manufacturing Petrochemicals Are Available—At a Price	Apr. 4	R-246

(CODE: BR—book review; Ed—editorial; IL—"Industrial Lubrication"; KU—"Keeping Up With the News")

Subject Index (Continued)

Subject	Article	Issue	Page
Engines (see also Diesel Engines and Postwar Engines)			
	Alcohol Tested as Injection Fluid for Gasoline Engines (Ed)	Feb. 7	R-160
	Alcohol-Water Injection as a Detonation Depressor in Gasoline Engines	Feb. 7	R- 88
	Discussion on Alcohol-Water Injection	Apr. 4	R-249
	Dual Fuel Diesel Engines Use Either Gas or Oil	May 2	R-396
	Obstacles Seen to a Two-Fuel System for General Use on Automobiles	Apr. 4	R-249
	Water Injection Alone Suppressed Detonation but Excessive Engine Rusting Was Found	Apr. 4	R-250
Engine Lubrication			
	Lubrication of Steam Engine Cylinders (IL)	May 2	R-329
	Lubrication of Steam Turbines (IL)	June 6	R-438
Equipment			
	Chemical Machinery (BR)	Jan. 3	R- 43
	Heat Transfer Equipment	Jan. 3	R- 16
Ethyl Chloride			
	Ethyl Chloride (KU)	June 6	R-456
Expansion Bends			
	Critical Materials Saved by Expansion U-Bends	Jan. 3	R- 15
Fireproofing			
	Analysis of Fireproofing Methods Used in Refinery Construction	Feb. 7	R- 86
Fischer-Tropsch Process			
	Chemical Utilization of Natural Gas	June 6	R-430
	Fischer-Tropsch Synthesis and the Petroleum Industry	Feb. 7	R- 97
	Synthine Defined (KU)	May 2	R-366
	Synthine Process (KU)	Feb. 7	R-128
	Synthine Production (KU)	Jan. 3	R- 48
Fluid Catalytic Cracking Process			
	"Cat Cracker" Turn-Around	Apr. 4	R-243
	Four Neighboring Refiners Install Joint Catalytic Cracking Unit	June 6	R-410
	Improved Fluid Process for Catalytic Cracking, The	Mar. 7	R-194
	2600 b/d Fluid Catalytic Cracking Unit Proves Successful on Initial 65-Day Run	Feb. 7	R- 83
Foreign Literature (translated from the Russian)			
	Condensation of Ethylene with Acetylene	Mar. 7	R-224
	Hydrocarbon Synthesis from Oxygenated Organic Compounds	Apr. 4	R-302
	Kinetics of the Process of Thermal Polymerization of Butadiene	June 6	R-466
	Polymerization of Mixtures of 1,3-Butadiene with 2-Butene and with Pentane by Sodium	Feb. 7	R-133
Formaldehyde			
	Formaldehyde (KU)	June 6	R-458
Fractionation			
	Multicomponent Fraction: A simplified Approach to Plate-to-Plate Calculations	Jan. 3	R- 53
	Pilot Unit Segregates Hydrocarbons by Groups for Calculating Data Used in Tower Design	Apr. 4	R-282
	Precise Fractionation in the Petroleum Industry	Mar. 7	R-169
Fuel Oil			
	Quality of Distillate Fuel Oils from Houdry and TCC Operations	Mar. 7	R-165
	Use of Cracked Gas Oils as Burner Fuels being Tested	Feb. 7	R-124
Fuels (see Postwar Fuels)			
Gasoline Motors (see Engines and Postwar Engines)			
Gas Turbines			
	Aeronautical Gas Turbines (KU)	Jan. 3	R- 48
	Jet Propulsion Fuels (KU)	May 2	R-364
Greases			
	Machine for Performance Tests of Antifriction Bearing Greases, A	Jan. 3	R- 25
	Torque-Viscosity Characteristics of Lubricating Greases	Feb. 7	R-150
Heat Exchangers			
	Heat Transfer Equipment	Jan. 3	R- 16
Houdry Catalytic Cracking Process			
	Design and Operating Features of Houdry Units	May 2	R-333
	Quality of Distillate Fuel Oils from Houdry and TCC Operations	Mar. 7	R-165
Hydrogen			
	Hydrogen (KU)	Apr. 4	R-292
Inspection			
	Inspection of Piping Systems	Jan. 3	R- 39
Instrumentation			
	Automatic Control Engineering (BR)	Jan. 3	R- 43
Isoprene			
	Production of Isoprene by Catalytic Dehydrogenation, The	Apr. 4	R-263
Laboratories (see Research Laboratories)			
Losses			
	Program for Loss Control in Manufacturing and Handling Operations	June 6	R-403
LPG (Liquefied Petroleum Gas)			
	Greater Light-Ends Recovery Is Design Trend in Natural Gasoline Plant Construction	May 2	R-323
	Increasing Propane Recovery in Existing Natural Gasoline Absorption Plants	May 2	R-389
	Liquefied Petroleum Gases (KU)	Apr. 4	R-290
	Progress of the LPG Industry During 1944	Feb. 7	R-108
	Propane and Ethane (KU)	Jan. 3	R- 44
	Wartime Trend of LP-Gas Industry	Mar. 7	R-226
Lubrication (see Engine Lubrication)			
Lubricants			
	Engine Oil Foaming	May 2	R-379
	Life Testing of Lubricating Oil	Jan. 3	R- 49
	Lubrication of Steam Engine Cylinders (IL)	May 2	R-329
	Lubrication of Steam Turbines (IL)	June 2	R-438
	Machine for Performance Tests of Antifriction Bearing Greases, A	Jan. 3	R- 25
	Maximizing Output from Wartime Plants Heads Refiners' Program for 1945	Mar. 7	R-163
	Piston Lacquering—Its Causes and Cures	Feb. 7	R-115
	Survey of Past and Present Trends in Lubricating Oil Additives	Jan. 3	R- 34
	Synthetic Aviation and Motor Oils Seen as Future Developments	Feb. 7	R-105
	Torque-Viscosity Characteristics of Lubricating Greases	Feb. 7	R-150
Lubricating Oil Manufacture			
	8250 b/d Canadian Refinery Is Complete, Even to Modern Lube Oil Manufacture	June 6	R-417
	New Solvent Lubricating Oil Plant Designed for Varying Blends of Crudes	Jan. 3	R- 7
Maintenance			
	"Cat Cracker" Turn-Around	Apr. 4	R-243
	Mechanical Operation of HF Alkylation Units	May 2	R-326
	Superstructures Aid in Tower Maintenance	Mar. 7	Cover
Natural Gas			
	Chemical Utilization of Natural Gas	June 6	R-430
	Products Obtainable from Natural Gas Hydrocarbons	Mar. 7	R-204
	Science in Natural Gas	Jan. 3	R- 11
	Texas Natural Gas (KU)	Mar. 7	R-212

(CODE: BR—book review; Ed—editorial; IL—"Industrial Lubrication"; KU—"Keeping Up With the News")

Subject Index (Continued)

Subject / Article	Issue	Page
Natural Gasoline		
Greater Light-Ends Recovery Is Design Trend in Natural Gasoline Plant Construction	May 2	R-323
Increasing Propane Recovery in Existing Natural Gasoline Absorption Plants	May 2	R-389
New Processes		
Process Development Program	Mar. 7	R-217
Patents		
Patent Developments (KU)	Mar. 7	R-212
Survey of Past and Present Trends in Lubricating Oil Additives	Jan. 3	R- 34
Personnel		
Better Plant Performance is Goal of Refinery Technical Division	May 2	R-393
Petroleum Technologists in the Armed Forces	May 2	R-370
Petroleum Technologists in the Armed Forces	June 6	R-478
Technologists Have Important Role in Postwar Refining (Ed)	Apr. 4	R-320
War's End Will not Terminate Shortage of Scientific Man-Power for Oil Companies	May 2	R-367
Petrochemicals		
Aromatic Hydrocarbons (KU)	Mar. 7	R-210
Carbon Disulfide (KU)	Feb. 7	R-132
Chemical Utilization of Natural Gas	June 6	R-430
Ethyl Chloride (KU)	June 6	R-456
Hydrocarbons for Petrochemicals	Apr. 4	Cover
Hydrogen (KU)	Apr. 4	R-292
New Chemical Company (KU)	Feb. 7	R-128
Petroleum Chemicals (KU)	May 2	R-364
Petroleum Sulfonates (KU)	Apr. 4	R-292
Products Obtainable from Natural Gas Hydrocarbons	Mar. 7	R-204
Propane and Ethane (KU)	Jan. 3	R- 44
Science in Natural Gas	Jan. 3	R- 11
Synthetic Ammonia (KU)	Feb. 7	R-132
Synthetic Ammonia (KU)	May 2	R-366
Synthetic Organic Chemicals (KU)	Feb. 7	R-130
Wartime Trend of LP-Gas Industry	Mar. 7	R-226
Wealth of Hydrocarbons for Manufacturing Petrochemicals Are Available—at a Price	Apr. 4	R-246
Physical Properties of Hydrocarbons		
New Volume Correction Factors Issued for C_4 Hydrocarbons	Jan. 3	R- 31
Liquid Densities of Volatile Hydrocarbon Mixtures	Mar. 7	R-213
Data on Thermal Expansion of Liquid Hydrocarbons Helpful in Field Studies	Apr. 4	R-293
Hydrocarbon Reference Samples Are Listed	June 6	R-486
Pilot Plants		
Pilot Unit Segregates Hydrocarbons by Groups for Calculating Data Used in Tower Design	Apr. 4	R-282
Process Development Program	Mar. 7	R-217
Plant Operation		
Better Plant Performance is Goal of Refinery Technical Division	May 2	R-393
Converting Thermal Plants to Catalytic Operation (Ed)	June 6	R-496
Four Neighboring Refiners Install Joint Catalytic Cracking Unit	June 6	R-410
Dehydration of Furnace Oil with Activated Alumina	Jan. 3	R- 63
Design and Operating Features of Houdry Units	May 2	R-333
Inspection of Piping Systems	Jan. 3	R- 39
Maximizing Output from Wartime Plants Heads Refiners' Program for 1945	Mar. 7	R-163
Program for Loss Control in Manufacturing and Handling Operations	June 6	R-403
24 Tray Water Wash Tower Removes Ammonia and Hydrogen Cyanide from "Cat Cracker" Products	June 6	R-406
Plants Describes		
British American Oil Co., Ltd., Toronto, Ontario. (8250 b/d Canadian Refinery Is Complete, Even to Modern Lube Oil Manufacture)	June 6	R-417
Champlin Refining Co., Enid, Okla. (New Solvent Lubricating Oil Plant Designed for Varying Blends of Crudes)	Jan. 3	R- 7
Cities Service Refining Co., Lake Charles, La. ("Cat Cracker" Turn-Around)	Apr. 4	R-243
Frontier Refining Co., Cheyenne, Wyo. (2600 b/d Fluid Catalytic Cracking Unit Proves Successful on Initial 65-Day Run)	Feb. 7	R- 83
Humble Oil & Refining Co., Baytown, Texas. (Baytown—Processes 200,000 Bbls. of Crude a Day)	Mar. 7	R-177
Koppers United Co., Kobuta, Pa. (Cooling Water and Effluent Treatment in Butadiene Manufacturing)	Apr. 4	R-273
Paloma Cycling Plant, Calif. (Paloma Cycling Plant Repressures 23 Wells at 10,000-11,000 Feet)	May 2	R-337
Pennzoil Oil Co., Oil City, Pa. (Four Neighboring Refiners Install Joint Catalytic Cracking Unit)	June 6	R-410
Tide Water Associated Oil Co., Avon, Calif. (New Plant Facilities Boost Aviation Gasoline Production Fifteen-Fold)	Mar. 7	R-174
Plant Design		
Analysis of Fireproofing Methods Used in Refinery Construction	Feb. 7	R- 86
Design and Operating Features of Houdry Units	May 2	R-333
Design Changes in Wartime Refineries Save Critical Materials	Jan. 3	R- 64
Critical Materials Saved by Expansion U-Bends	Jan. 3	R- 15
Greater Light-Ends Recovery is Design Trend in Natural Gasoline Plant Construction	May 2	R-323
Increasing Propane Recovery in Existing Natural Gasoline Absorption Plants	May 2	R-389
Multicomponent Fractionation: A Simplified Approach to Plate-to-Plate Calculations	Jan. 3	R- 53
Paloma Cycling Plant Repressures 23 Wells at 10,000-11,000 Feet	May 2	R-337
Superstructures Aid in Tower Maintenance	Mar. 7	Cover
263-Ton Hortonsphere Built on Timber Bed, Moved 800 Ft. Intact	June 6	R-487
Vibration in Compressor Plant Piping	Feb. 7	R-138
Wartime Design Features for Normal Practice (Ed.)	Mar. 7	R-240
Plastics		
Plastics, Scientific and Technological (BR)	May 2	R-384
Styraloy (KU)	June 6	R-454
Polymerization		
Kinetics of the Process of Thermal Polymerization of Butadiene	June 6	R-466
Polymerization of Mixtures of 1,3 Butadiene with 2-Butene and with Pentane by Sodium	Feb. 7	R-133
Postwar Automobiles		
Automobile Developments (KU)	Feb. 7	R-130
Automobile News (KU)	Apr. 4	R-290
Automobile News (KU)	May 2	R-364

(CODE: BR—book review; Ed—editorial; IL—"Industrial Lubrication"; KU—"Keeping Up With the News")

Subject Index (Continued)

Subject	Article	Issue	Page
	Gasless Automobile (KU)	Mar. 7	R-209
	Postwar Automobiles (KU)	Jan. 3	R- 46
Postwar Engines			
	Possibilities of Gasoline Engine Development	May 2	R-346
	Postwar Internal Combustion Engines and Their Fuels	Jan. 3	R- 66
Postwar Fuels			
	Jet Propulsion Fuels (KU)	May 2	R-364
	Postwar Fuels for Prewar Cars (Ed.)	May 2	R-400
	Postwar Internal Combustion Engines and Their Fuels	Jan. 3	R- 66
	Synthetic Aviation and Motor Oils Seen as Future Developments	Feb. 7	R-105
Rubber (see Synthetic Rubber)			
Research			
	"Foolish" Research Has Paid Big Dividends (Ed.)	Feb. 7	R-160
	Guidance on the Research Problem (Ed.)	Mar. 7	R-240
	Industrial Research Should Be the Keystone in Our Postwar Preparedness Program (Ed.)	Jan. 3	R- 80
	Maximizing Output from Wartime Plants Heads Refiners' Program for 1945	Mar. 7	R-163
	Navy Seeks Answers to Puzzling Problems	Mar. 7	R-223
	Nonlaboratory Chemistry (KU)	June 6	R-458
Research Laboratories			
	Phillips Petroleum Co., Phillips, Texas. (Cutting the Lag Between Research and Commercial Refining)	Mar. 7	R-187
	Sun Oil Co., Marcus Hook, Pa. (New Devices Save Time and Labor in Setting Up Engine Test Stands)	Apr. 4	R-257
Rubber (See Synthetic Rubber)			
Safety			
	National Fire Codes for Flammable Liquids, Gases, Chemicals and Explosives, 1945. (BR)	May 2	R-384
	Preventing Explosive Atmospheres by Dilution with Inert Gases	Mar. 7	R-236
Steam Turbines			
	Lubrication of Steam Turbines (IL)	June 6	R-438
Storage			
	Contribution to Conservation (Ed)	May 2	R-400
	Evaporation Losses of Aviation Gasoline in Standing Storage:		
	Part 1—Tests with Blended Aviation Gasoline	Apr. 4	R-252
	Part 2—Tests with Blending Stocks	May 2	R-373
	263-Ton Hortonsphere Built on Timber Bed, Moved 800 Ft. Intact	June 6	R-487
Sulfur Removal (See Desulfurization)			
Synthetic Ammonia			
	Chemical Utilization of Natural Gas	June 6	R-430
	Synthetic Ammonia (KU)	Feb. 7	R-132
	Synthetic Ammonia (KU)	May 2	R-366
Synthetic Fuels and Lubricants			
	Costs of Oil from Coal and Shale	Mar. 7	R-205
	Fischer-Tropsch Synthesis and the Petroleum Industry	Feb. 7	R- 97
	Hydrocarbon Synthesis from Oxygenated Organic Compounds	Apr. 4	R-302
	Synthetic Aviation and Motor Oils Seen as Future Developments	Feb. 7	R-105
	Synthine Production (KU)	Jan. 3	R- 48
	Synthine Process (KU)	Feb. 7	R-128
Synthetic Rubber			
	Chemical Utilization of Natural Gas	June 6	R-430
	Maximizing Output from Wartime Plants Heads Refiners' Program for 1945	Mar. 7	R-163
	New Methods Introduced in GR-S Processing	Jan. 3	R- 3
	Synthetic Rubber, Postwar (KU)	Mar. 7	R-209
Synthine Process (see Fischer-Tropsch Process)			
Tank Bottoms			
	Tank Bottoms Seen as Source of Microcrystalline Waxes	June 6	R-460
TCC Catalytic Cracking Process			
	Quality of Distillate Fuel Oils from Houdry and TCC Operations	Mar. 7	R-165
	TCC Catalytic Cracking Process for Motor Gasoline Production, The	June 6	R-441
Tests			
	Engine Oil Foaming	May 2	R-379
	Life Testing of Lubricating Oil	Jan. 3	R- 49
	Machine for Performance Tests of Antifriction Bearing Greases, A	Jan. 3	R- 25
	New Technique for Flame Combustion Photography (Ed)	June 6	R-496
	Piston Lacquering—Its Causes and Cures	Feb. 7	R-115
	Torque-Viscosity Characteristics of Lubricating Greases	Feb. 7	R-150
	Use of Cracked Gas Oil as Burner Fuels Being Tested	Feb. 7	R-124
Toluene			
	Maximizing Output from Wartime Plants Heads Refiners' Program for 1945	Mar. 7	R-163
	Toluene by Hydroforming (KU)	Jan. 3	R- 44
U. S. Bureau of Mines Reports			
	Catalytic Desulfurization Improves Lead Susceptibility of "Sour" Distillates (R.I. 3729—Effect of Desulfurization on the Lead Susceptibility of Distillates from Some Crude Oils from Texas, New Mexico and Oklahoma)	Apr. 4	R-309
	Data on Thermal Expansion of Liquid Hydrocarbons Helpful in Field Studies (R.I. 3772—Thermal Expansion of Pressure Samples of Hydrocarbon Liquids from Gas-Condensate Wells)	Apr. 4	R-293
	Evaporation Losses of Aviation Gasoline In Standing Storage (R.I.—3701):		
	Part 1—Tests with Blended Aviation Gasoline	Apr. 4	R-252
	Part 2—Tests with Blending Stocks	May 2	R-373
	Preventing Explosive Atmospheres by Dilution with Inert Gases (R.I. 3787—Prevention of Benzene-Air Explosions by Addition of Nitrogen and Carbon Dioxide)	Mar. 7	R-236
	Products Obtainable from Natural Gas Hydrocarbons (I.C. 7108—Utilization of Natural Gas for Chemical Products)	Mar. 7	R-204
U. S. Bureau of Standards Reports			
	New Volume Correction Factors Issued for C_4 Hydrocarbons (L.C. 757)	Jan. 3	R- 31
Volume Correction Factor			
	New Volume Correction Factors Issued for C_4 Hydrocarbons	Jan. 3	R- 31
Waxes			
	Tank Bottoms Seen as Source of Microcrystalline Waxes	June 6	R-460

Author Index

Author	Title	Issue	Page
Adams, E. W.	—Torque-Viscosity Characteristics of Lubricating Greases (also by E. E. Ziegler and L. C. Brunstrum)	Feb. 7	R-150
Ambrose, H. A.	—Engine Oil Foaming (also by C. E. Trautman)	May 2	R-379
Anderson, D. E.	—Alcohol-Water Injection as a Detonation Depressor in Gasoline Engines (also by A. T. Colwell and R. E. Cummings)	Feb. 7	R- 88
Arnold, M. L.	—Vibration in Compressor Plant Piping	Feb. 7	R-138
Barnebey, H. L.	— Process Development Program	Mar. 7	R-217

(CODE: BR—book review; Ed—editorial; IL—"Industrial Lubrication"; KU—"Keeping Up With the News")

Author Index (Continued)

Author	Title	Issue	Page
Barton, Arthur C.—	Inspection of Piping Systems (also by Wes Miller)	Jan. 3	R- 39
Baster. Forest S.—	Possibilities of Gasoline Engine Development	May 2	R-346
Bell, Harold S.—	Costs of Oil from Coal and Shale	Mar. 7	R-205
Bell, F. W.—	Increasing Propane Recovery in Existing Natural Gasoline Absorption Plants	May 2	R-389
Blaylock, P. W.—	Heat Transfer Equipment	Jan. 3	R- 16
Boyd, Jr., J. H.—	Wealth of Hydrocarbons for Manufacturing Petrochemicals Are Available—at a Price	Apr. 4	R-246
Brown, C. L.—	The Improved Fluid Process for Catalytic Cracking (also by E. J. Gohr, C. E. Jahnig, H. Z. Martin, C. W. Tyson and E. V. Murphree)	Mar. 7	R-194
Brown, Geo. Granger—	Liquid Densities of Volatile Hydrocarbon Mixtures (also by George H. Hanson and Blaine B. Kuist)	Mar. 7	R-213
Brummerstedt, E. F. —	Analysis of Fireproofing Methods Used in Refinery Construction	Feb. 7	R- 86
Brunstrum, L. C.—	Torque-Viscosity Characteristics of Lubricating Greases (also by E. W. Adams and E. E. Ziegler)	Feb. 7	R-150
Cauley, S. P.—	Quality of Distillate Fuel Oils from Houdry and T.C.C. Operations (also by S. D. Dalton)	Mar. 7	R-165
Colwell, A. T.—	Alcohol-Water Injection as a Detonation Depressor in Gasoline Engines (also by R. E. Cummings and D. E. Anderson)	Feb. 7	R- 88
Cummings, R. E.—	Alcohol-Water Injection as a Detonation Depressor in Gasoline Engines (also by D. E. Anderson and A. T. Colwell)	Feb. 7	R- 88
Dalton, S. D.—	Quality of Distillate Fuel Oils from Houdry and T.C.C. Operations (also by S. P. Cauley)	Mar. 7	R-165
Dotterweich, Frank H.—	Science in Natural Gas (also by James E. Pew)	Jan. 3	R- 11
Dunham, G. S. —	The T.C.C. Catalytic Cracking Process for Motor Gasoline Production (also by R. H. Newton and T. P. Simpson)	June 6	R-441
Eidus, Ya. T.—	Hydrocarbon Synthesis from Oxygenated Organic Compounds	Apr. 4	R-302
Exline, Paul G.—	A Machine for Performance Tests of Antifriction Bearing Greases (also by S. A. Flesher)	Jan. 3	R- 25
Fedoseev, P. —	Condensation of Ethylene with Acetylene (also by N. Kozlov)	Mar. 7	R-224
Findlay, R. A.—	Mechanical Operation of HF Alkylation Units	May 2	R-326
Flesher, S. A.—	A Machine for Performance Tests of Antifriction Bearing Greases (also by Paul G. Exline)	Jan. 3	R- 25
Forbes, W. G.—	Industrial Lubrication: 1. Lubrication of Steam Engine Cylinders	May 2	R-329
	2. Lubrication of Steam Turbines	June 6	R-438
Gohr, E. J.—	The Improved Fluid Process for Catalytic Cracking (also by C. E. Jahnig, H. Z. Martin, C. W. Tyson, E. V. Murphree and C. L. Brown)	Mar. 7	R-194
Grandone, Peter.—	Evaporation Losses of Aviation Gasoline in Standing Storage: Part 1. Tests with Blended Aviation Gasoline	Apr. 4	R-252
	Part 2. Tests with Blending Stocks	May 2	R-373
Hanson, George H.—	Liquid Densities of Volatile Hydrocarbon Mixtures (also by Blaine B. Kuist and Geo. Granger Brown)	Mar. 7	R-213
Hummel, H. H.—	Multicomponent Fractionation (A Simplified Approach to Plate-to-Plate Calculations)	Jan. 3	R- 53
Hunter, H. C.—	Obstacles Seen to a Two-Fuel System for General Use on Automobiles	Apr. 4	R-249
Jacomini, V. V.—	Greater Light-Ends Recovery Is Design Trend in Natural Gasoline Plant Construction	May 2	R-323
Jahnig, C. E.—	The Improved Fluid Process for Catalytic Cracking (also by H. Z. Martin, C. W. Tyson, E. V. Murphree, C. L. Brown and E. J. Gohr)	Mar. 7	R-194
Khokhlovkin, M. A.—	Kinetics of the Process of Thermal Polymerization of Butadiene (also by S. V. Lebedev and N. I. Kuibina)	June 6	R-466
Komarewsky, V. I.—	Fischer-Tropsch Synthesis and the Petroleum Industry (also by C. H. Riesz)	Feb. 7	R- 97
Kozlov, N.—	Condensation of Ethylene with Acetylene (also by P. Fedoseev)	Mar. 7	R-224
Kuibina, N. I.—	Kinetics of the Process of Thermal Polymerization of Butadiene (also by S. V. Lebedev and M. A. Khokhlovkin)	June 6	R-466
Kuist, Blaine B.—	Liquid Densities of Volatile Hydrocarbon Mixtures (also by Geo. Granger Brown and George H. Hanson)	Mar. 7	R-213
Lebedev, S. V.—	Kinetics of the Process of Thermal Polymerization of Butadiene (also by M. A. Khokhlovkin and N. I. Kuibina)	June 6	R-466
Lekakh, M. Yu.—	Polymerization of Mixtures of 1,3-Butadiene with 2-Butene and with Pentane by Sodium (also by I. V. Rokityanskii)	Feb. 7	R-133
Lemen, W. E.—	Four Neighboring Refiners Install Joint Catalytic Cracking Unit (also by Paul Truesdell)	June 6	R-410
Martin, H. Z.—	The Improved Fluid Process for Catalytic Cracking (also by C. W. Tyson, E. V. Murphree, C. L. Brown, E. J. Gohr and C. E. Jahnig)	Mar. 7	R-194
Mavity, Julian M.—	The Production of Isoprene by Catalytic Dehydrogenation (also by Earl E. Zetterholm)	Apr. 4	R-263
McAllister, E. W.—	Paloma Cycling Plant Repressures 23 Wells at 10,000-11,000 Feet	May 2	R-337
McClintock, J. H.—	Program for Loss Control in Manufacturing and Handling Operation (also by R. S. Piroomov)	June 6	R-403
Mendius, Wm.—	Alkylation—Backbone of Aviation Gasoline	June 6	R-407
Miller, Benjamin.—	Chemical Utilization of Natural Gas	June 6	R-430
Miller, Walter.—	Maximizing Output from Wartime Plants Heads Refiners' Program for 1945	Mar. 7	R-163
Miller, Wes.—	Inspection of Piping Systems (also by Arthur C. Barton)	Jan. 3	R- 39
Mougey, H. C.—	Life Testing of Lubricating Oil	Jan. 3	R- 49
Mougey, H. C. —	Piston Lacquering — Its Causes and Cures	Feb. 7	R-115
Murphree, E. V. —	The Improved Fluid Process for Catalytic Cracking (also by C. L. Brown, E. J. Gohr, C. E. Jahnig, H. Z. Martin and C. W. Tyson)	Mar. 7	R-194
Newman, W. R.—	2600 b/d Fluid Catalytic Cracking Unit Proves Successful on Initial 65-Day Run	Feb. 7	R- 83
Newton, R. H. —	Design and Operating Features of Houdry Units (also by H. G. Shimp)	May 2	R-333

Author Index (Continued)

Author	Title	Issue	Page
Newton, R. H.	The TCC Catalytic Cracking Process for Motor Gasoline Production (also by G. S. Dunham and T. P. Simpson)	June 6	R-441
Oberfell, G. G.	Progress of the LPG Industry During 1944 (also by R. W. Thomas)	Feb. 7	R-108
Pew, James E.	Science in Natural Gas (also by Frank H. Dotterweich)	Jan. 3	R- 11
Piroomov, R. S.	Program for Loss Control in Manufacturing and Handling Operations (also by J. H. McClintock)	June 6	R-403
Rendel, T. B.	Postwar Internal Combustion Engines and Their Fuels	Jan. 3	R- 66
Reuter, Raymond.	The Use of Chemicals by the Petroleum Industry	Jan. 3	R- 76
Riesz, C. H.	Fischer-Tropsch Synthesis and the Petroleum Industry (also by V. I. Komarewsky)	Feb. 7	R- 97
Rokityanskii, I. V.	Polymerization of Mixtures of 1,3-Butadiene with 2-Butene and with Pentane by Sodium (also by M. Yu. Lekakh)	Feb. 7	R-133
Shimp, H. G.	Design and Operating Features of Houdry Units (also by R. H. Newton)	May 2	R-333
Simpson, T. P.	The T.C.C. Catalytic Cracking Process for Motor Gasoline Production (also by R. H. Newton and G. S. Dunham)	June 6	R-441
Stein, Paul J.	Cooling Water and Effluent Treatment in Butadiene Manufacturing	Apr. 4	R-273
Stossel, Ernest.	Tank Bottoms Seen as Source of Microcrystalline Waxes	June 6	R-460
Test, L. J.	Water Injection Alone Suppressed Detonation But Excessive Engine Rusting Was Found	Apr. 4	R-250
Thomas, R. W.	Progress of the LPG Industry During 1944 (also G. G. Oberfell)	Feb. 7	R-108
Thompson, Paul K.	Wartime Trend of LP-Gas Industry	Mar. 7	R-226
Thornton, Jr., D. P.	New Volume Correction Factors Issued for C_4 Hydrocarbons	Jan. 3	R- 31
Thornton, Jr., D. P.	Baytown—Processes 200,000 Bbls. of Crude a Day	Mar. 7	R-177
Thornton, Jr., D. P.	War's End Will Not Terminate Shortage of Scientific Manpower for Oil Companies	May 2	R-367
Trautman, C. E.	Engine Oil Foaming (also by H. A. Ambrose)	May 2	R-379
Truesdell, Paul	Four Neighboring Refiners Install Joint Catalytic Cracking Unit (also by W. E. Lemen)	June 6	R-410
Tyson, C. W.	The Improved Fluid Process for Catalytic Cracking (also by E. V. Murphree, C. L. Brown, E. J. Gahr, C. E. Jahnig and H. Z. Martin)	Mar. 7	R-194
Verity, P. S.	Precise Fractionation in the Petroleum Industry	Mar. 7	R-169
Wright, W. Andrew.	Survey of Past and Present Trends in Lubricating Oil Additives	Jan. 3	R- 34
Zetterholm, Earl E.	The Production of Isoprene by Catalytic Dehydrogenation (also by Julian M. Mavity)	Apr. 4	R-263
Ziegler, E. E.	Torque-Viscosity Characteristics of Lubricating Greases (also by L. C. Brunstrum and E. W. Adams)	Feb. 7	R-150

ADVERTISERS' INDEX

Alco Products Division	R-481
Alcorn Combustion Co.	R-488
Aluminum Ore Co.	R-489
American Cyanamid & Chemical Corp.	R-457
American Meter Co.	R-473
Attapulgus Clay Co.	R-429
Badger & Sons Co., E. B.	R-448—R-449
Babcock & Wilcox Tube Co.	R-459
Beaird Co., J. B.	R-468
Bechtel-McCone Corp.	R-427
Clark Bros. Co., Inc.	R-419
Consolidated Engineering Corp.	R-435
Cooper-Bessemer Corp.	R-439
Dow Chemical Co.	R-461
Edward Valve & Mfg. Co., Inc.	R-421
Ethyl Corp.	R-402
Foster Wheeler Corp.	Insert
Foxboro Co.	R-465
General Chemical Co.	Inside Back Cover
Graver Tank & Mfg. Co., Inc.	R-425
Hammond Iron Works	R-437
Houdry Process Corp.	R-445
Hudson Engineering Corp.	Inside Front Cover
Johns-Manville Corp.	R-471
Jones & Laughlin Supply Co.	R-476—R-477
Lummus Co.	Insert
McKee & Co., Arthur G.	R-413
Metasap Chemical Co.	R-495
Monsanto Chemical Co.	R-431
National Petroleum News	R-485
Nooter Boiler Works Co., John	R-451
Petroleum Engineering, Inc.	R-422—R-423
Porocel Corp.	R-443
Powell Co., Wm.	R-467
Solvay Sales Corp.	R-455
Stratford Engineering Corp.	R-483
Texaco Development Corp.	R-463
Union Asbestos & Rubber Co.	R-479
Universal Oil Products Co.	R-415
Warren Petroleum Corp.	R-453
Wyatt Metal & Boiler Works	Outside Back Cover
Zink Burner Co., John	R-475

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WIDENING HORIZONS

Views on Personnel, Management and Economic as Well as Technological Developments in Petroleum Refining and Natural Gas Processing: Comment from Readers Is Invited

Converting Thermal Plants To Catalytic Operations

THE most recent development in catalytic cracking, the conversion of a small thermal cracking unit to a catalytic operation, will be followed with great interest by the many refiners with similar types of plants. There are well over 100 interior refineries with thermal installations only, who face the coming postwar problem of how to operate their plants in the face of the competition of the catalytic plants, which are largely installed in the coastal refineries.

The conversions of thermal plants to catalytic operations which have previously been announced have been of large units. Tide Water Associated Oil Co. in its annual report stated that two large thermal units at its Bayonne refinery were being converted to a Thermofor catalytic unit. As described this was essentially a contribution to the wartime aviation gasoline program. The operation of these new facilities, it was stated, is to be integrated with that of the existing Houdry unit to permit the manufacture of increased quantities of finished aviation gasoline base stock sufficient to double the ultimate volume of 100-octane aviation gasoline produced.

An 11-year-old thermal cracking plant at Sun Oil Co.'s Marcus Hook refinery also has been converted to a Thermofor catalytic operation, by retubing the furnace and altering the fractionating tower of the thermal installation, among other changes. Prior to the conversion the thermal unit had been utilized in a topping operation, processing some 27,000 bbls. of crude oil daily. Two gas oil thermal units which were unsuitable for reforming naphthas were converted to crude topping to take the place of the former topping operation in the thermal unit.

As far as is known, the conversion of a thermal cracking plant to a catalytic operation as recently announced for the St. Louis, Mich., refinery of Leonard Refineries, Inc., is the first involving a small installation. The Leonard plant is a 1500 b/d, two-coil UOP thermal recycle plant. It is proposed to install a 3000 bbl. TCC reactor and regenerator, utilizing the fractionating system, furnace and gas conversion unit of the thermal system. Operated on a once-through basis, the capacity of the thermal facilities can be expanded to work in with the 3000-bbl. catalytic unit.

The cost of the conversion is estimated by the Lummus Co., the contracting engineers, at around $750,000, or approximately $250 per barrel of throughput. The cost of an entirely new TCC installation of this capacity would be around $1,200,000, it is stated, or $400 per bbl. throughput.

The numerous refineries located in the interior sections of the country have, all told, around 750,000 bbls. thermal cracking capacity, as compared with around 200,000 bbls. of catalytic cracking capacity in those parts of the country. A great many of these individual thermal units are of 2000 and 3000 bbl. capacity; many, in fact, are listed at under 1000 bbls. The large refineries on the Atlantic and Gulf and West Coasts, which have over 800,000 bbls. of catalytic cracking capacity, also have over 1,000,000 bbls. in thermal cracking capacity. Some of this thermal capacity was supplanted or converted to other operations when the catalytic units were installed in the same plants and what figure it will cut in postwar motor fuel manufacturing is not known at present.

The cracking capacity of the interior refineries, however, is important because of its geographical location as well as the total volume of refining facilities the plants provide. The products they turn out such as kerosine, heating oils, diesel fuels, and others are increasing in over-all demand. The motor gasolines they produce will provide a satisfactory fuel for the large numbers of old cars that will be on the road for two or three years after the war or even longer. Individually these plants have marketing territories they are strategically located to serve.

In view of these natural advantages and with the aid of improvements in refining technology now being directed to apply to the small refineries, of which the conversion to catalytic cracking discussed above is an illustration, the transition from wartime to peacetime operations for these plants may not be as dislocating as some have feared.

New Technique for Flame Combustion Photography

MOTION pictures taken at the rate of 40,000 photographs a second showing the injection and combustion of fuel in a Diesel engine, as observed through the glass window in a cylinder head, were shown at the Fuels and Lubricants meeting of the Cleveland section of the Society of Automotive Engineers May 17. Yes, 40,000 photographs per second is right.

To give some idea of the advance in high speed motion picture technique thus represented, the speaker, Cearcy D. Miller, engineer at the NACA Aircraft Engine Research Laboratory at Cleveland, gave some comparative facts. For ordinary motion pictures 16 to 24 photographs per second are taken; in sports events up to 100 are taken. The earlier motion pictures of the combustion of fuel sprays were done with a high speed camera operating at rates as high as 2500 photographs per second.

The faster camera taking 40,000 photographs per second was developed by the NACA at Langley Field, Va., where the pictures shown at the Cleveland meeting were taken in 1940. The technique of this new high speed photography has not been made public. In projecting the pictures on the screen the processes of combustion shown are slowed down to 2500 times their true duration. At this same rate of slow speed, a baseball player would take 3½ hours to cover the distance from home plate to first base, said Mr. Miller.

The high speed photographs shown with his paper entitled, "Slow Motion Study of Injection and Combustion of Fuel in a Diesel Engine", demonstrated the better fuel distribution provided by the multiple-orifice nozzle as compared with the single-orifice nozzle. They showed how Diesel knock, associated with short inflammation time, develops with increasing the injection-advance angle. They are considered to have demonstrated how fuel mixtures too lean for combustion may be formed by early injection with very small fuel quantities, whereas the same mixtures will burn with later injection because of the concentration of the fuel in droplets. It is to be hoped that this new technique will be applied to photographing flame combustion in the cylinder of a gasoline engine.

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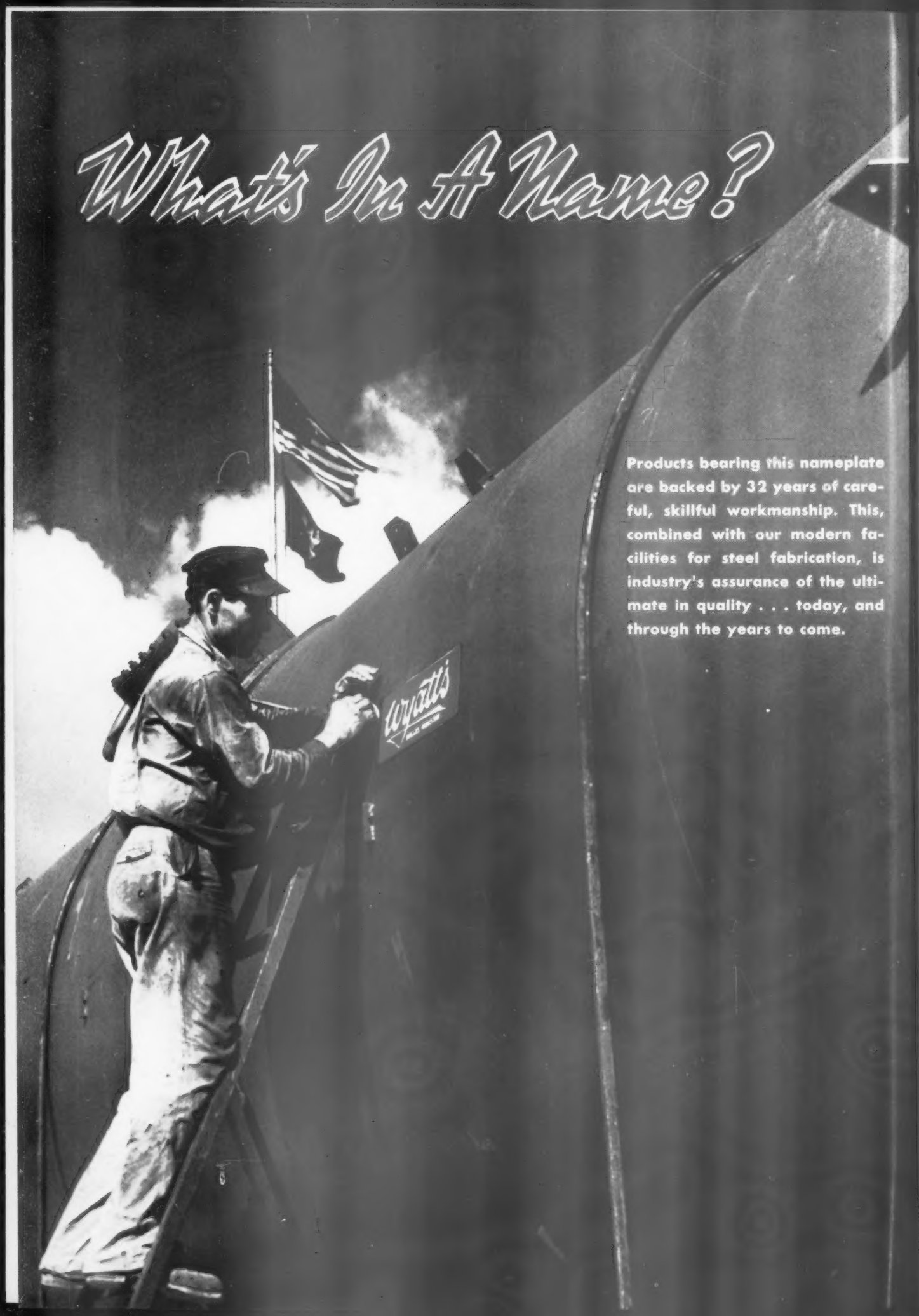

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